THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXIX. No. 1780.] LONDON, JUNE 22, 1897. [49TH YEAR. PRICE 6d.

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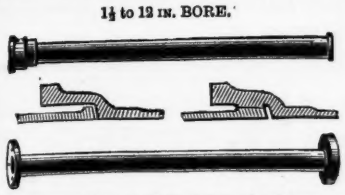
1¼ to 12 IN. BORE.



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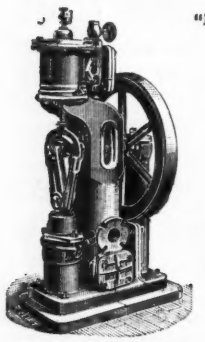

Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

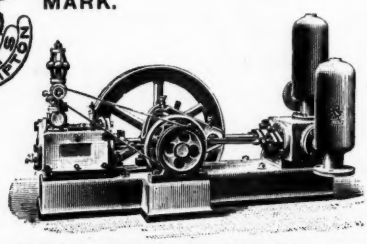

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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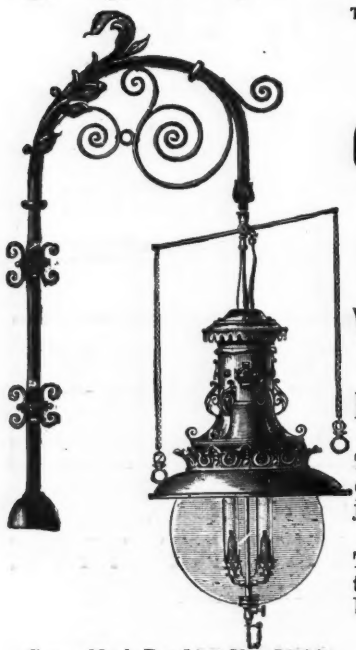

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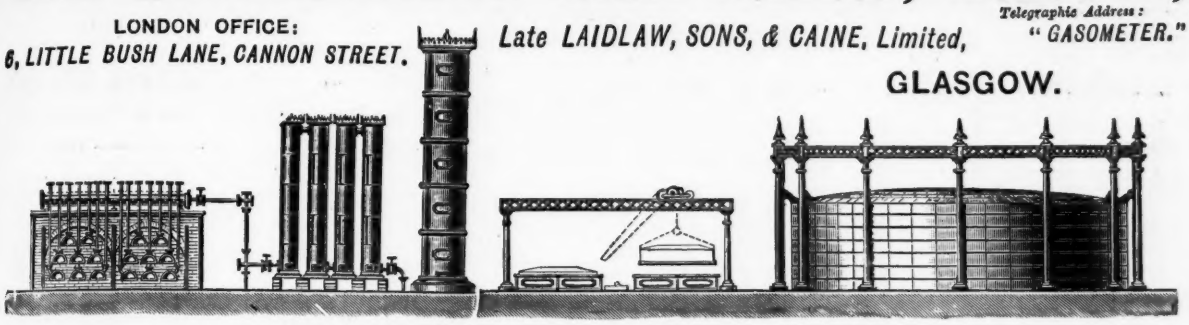

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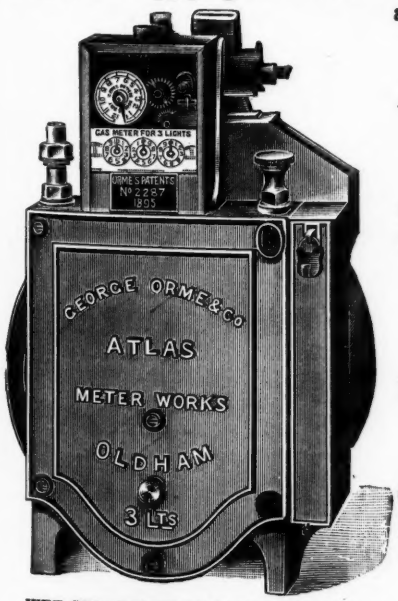

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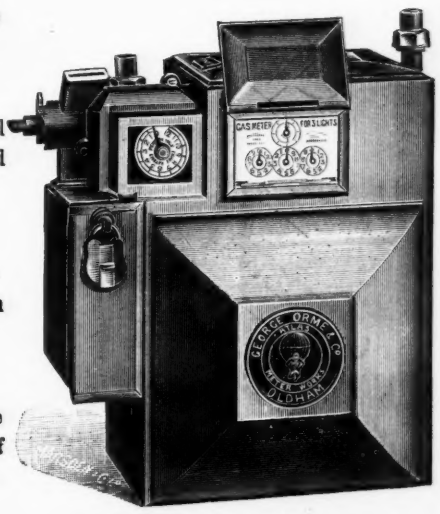

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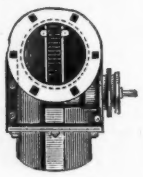

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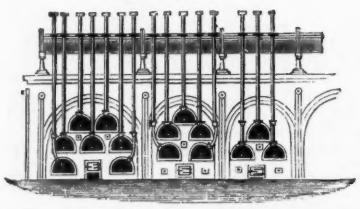

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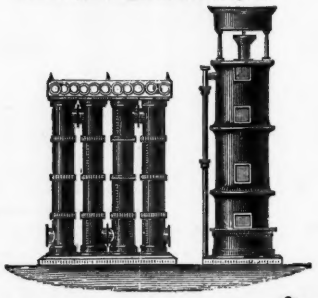

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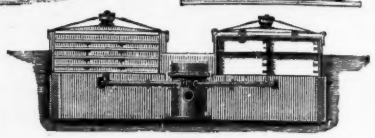

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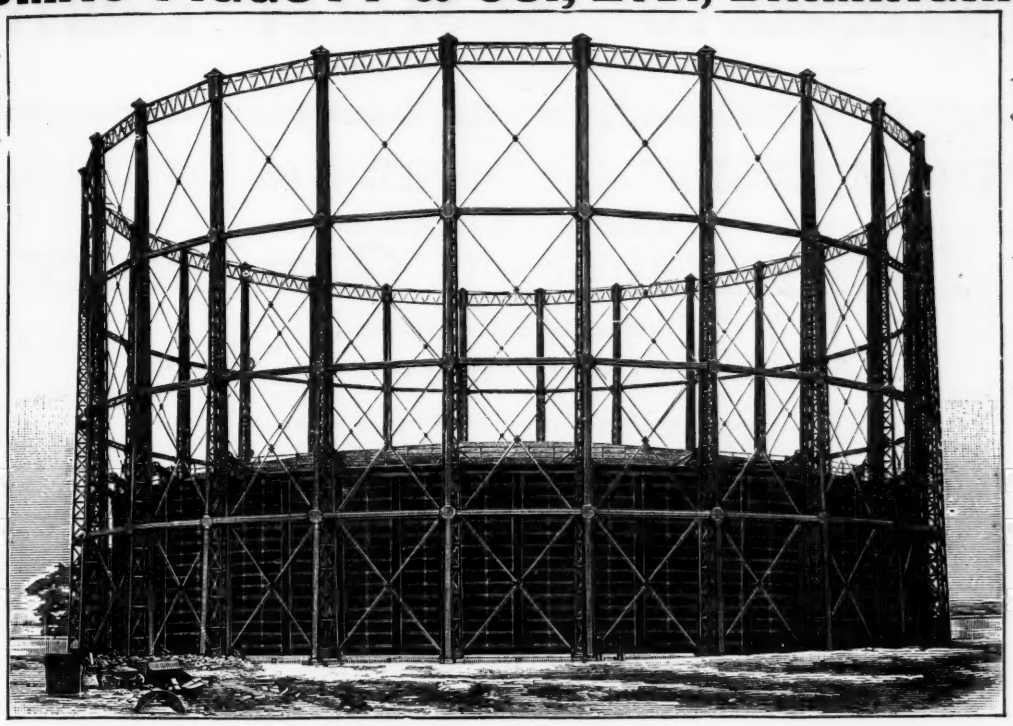

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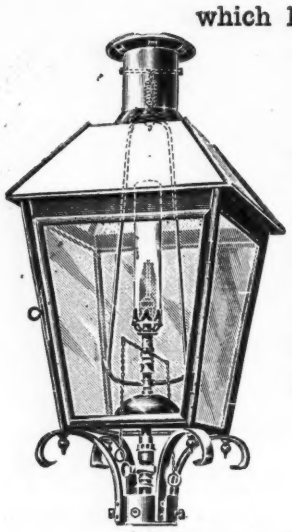

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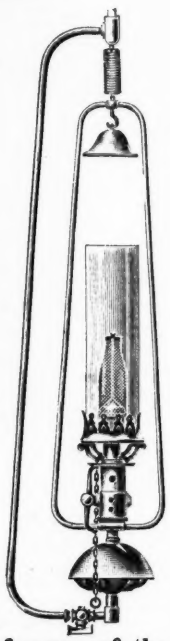

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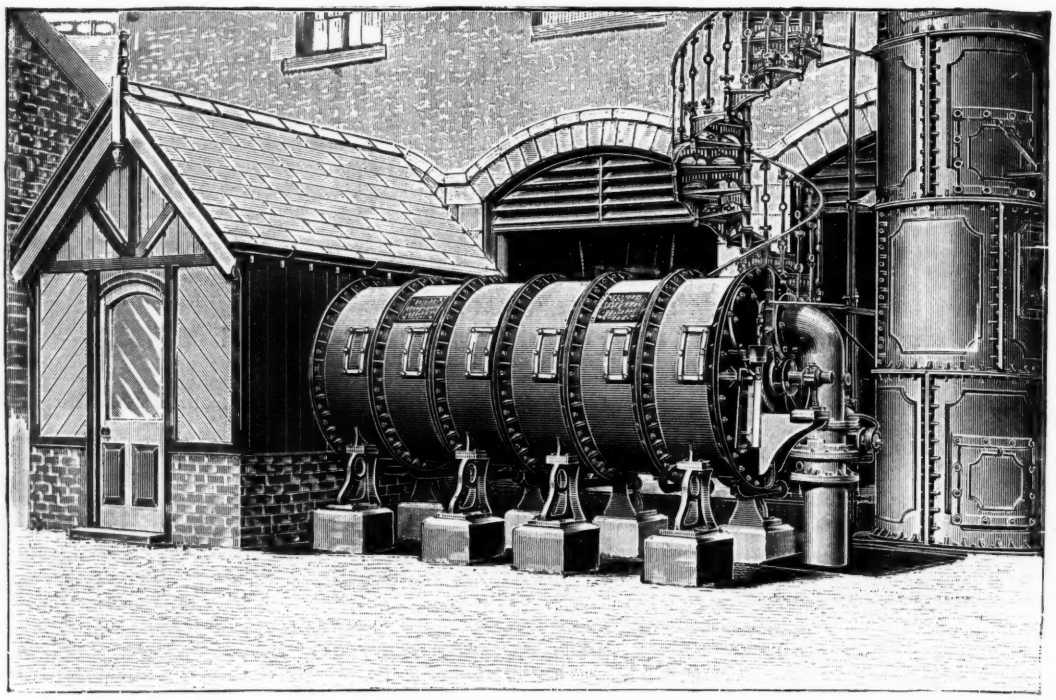

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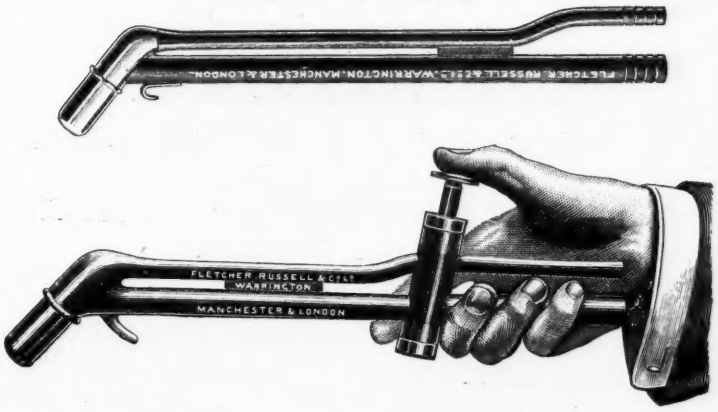

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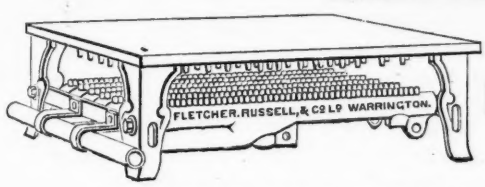

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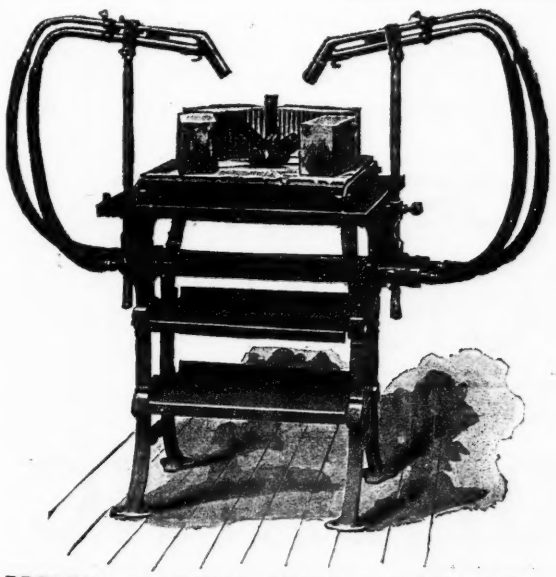

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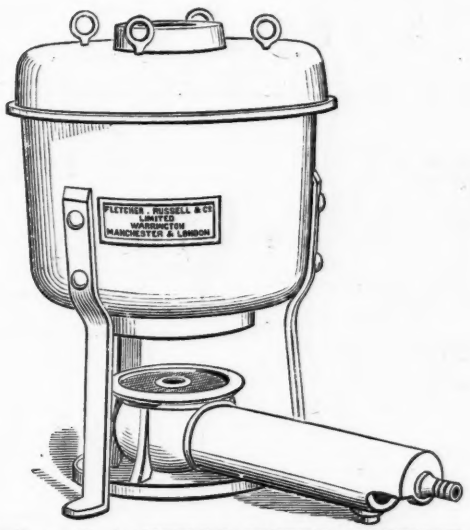

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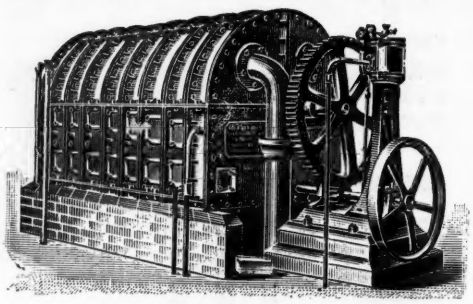

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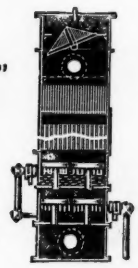

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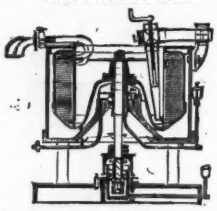

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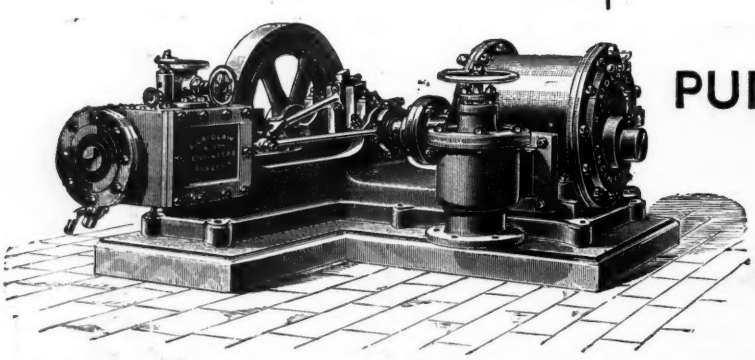

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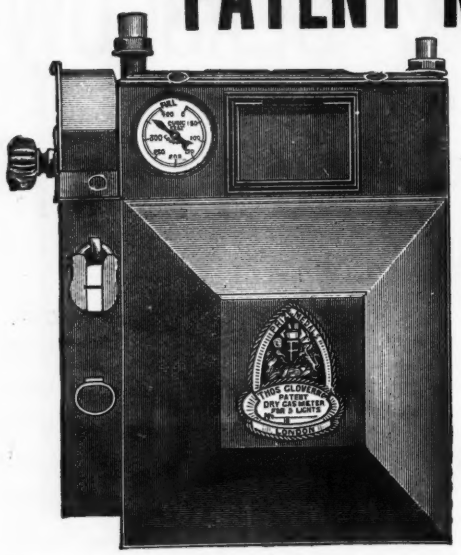

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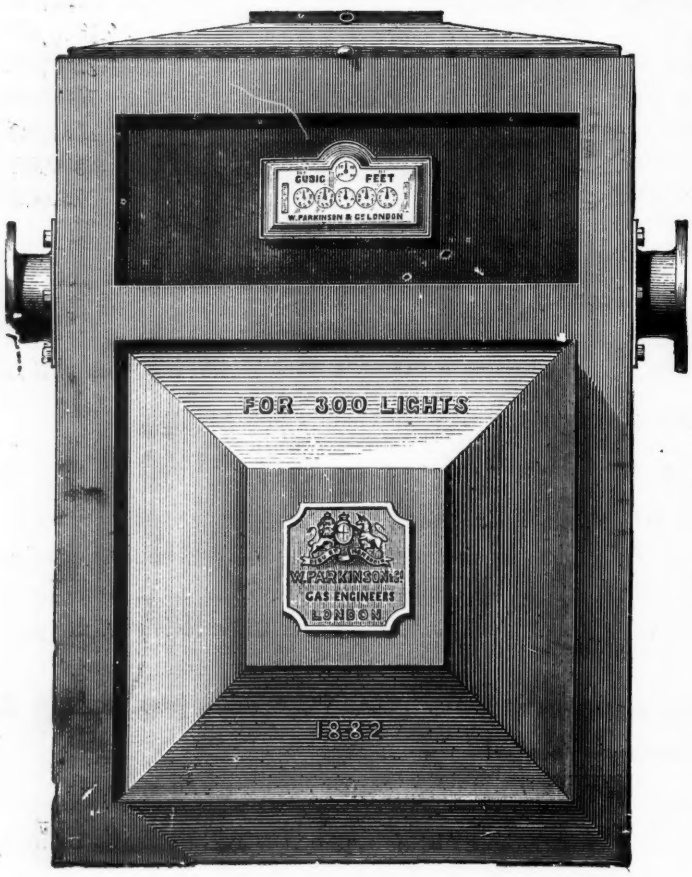

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EDITORIAL NOTES.

The Gas Institute at Bath.

THE meeting of the Incorporated Gas Institute was held in Bath last week, under the presidency of Mr. C. S. Ellery, the Engineer of the Bath Gas Company, and was more successful in point of attendance than was to be feared in the special circumstances. Still, the necessity of interposing the meeting between Whitsuntide and the Diamond Jubilee week undoubtedly deterred many members from journeying to Bath; and the number of those who did so for only a part of the time allotted to the meetings was considerable. Consequently, many familiar figures were absent; and some well-known names will not appear in the record of proceedings. Those members who were present were laudably punctual and regular in supporting the Chair; and if anything could compensate for the lack of so many old favourites, it would be the conspicuous participation in the transactions of a strong contingent of new contributors. Apart from these deterrents, the conditions of the meeting were most favourable to success. Bath was a popular fixture; and those visitors who made the—in many cases—long pilgrimage to the fair and beautifully-situated city, were well satisfied with the return for their pains. Bath is a pretty and interesting place; and the Local Authorities laid themselves out in the most hospitable spirit to welcome and provide entertainment for the Institute. Nothing could be more gracious and liberal than the hospitality and countenance extended to the Institute by the Mayor of Bath—Mr. George Woodiwiss—whose conduct is to be regarded as inspired by the purest public spirit and an overflowing goodheartedness, because the Corporation have nothing to do with the gas supply. The meetings were all held in the Guildhall, which is certainly, with its annexes, one of the most suitable and convenient buildings that has ever been placed at the disposal of the Institute for the purpose. This is a circumstance that unquestionably favoured the regular and full attendances that characterized the three days' session; for it is impossible to procure good meetings when the hall is defective in any respect.

In accounting for the success of a meeting of this kind, due allowance must be made for the influence of the Chair. Mr. Ellery was comparatively a "dark horse" to the great majority of the members; but his conduct in the chair on this occasion was such as to place him in the front rank of those who have enhanced their reputation by their service to the Institute in this high office. His Inaugural Address was kept studiously moderate in tone and restrained in scope; and his management of the meeting was admirable. It is not too much to describe him as one of the most businesslike Presidents the Institute has ever had. Some occupants of the position have "spread themselves," and imposed their personality upon the meeting in a way to sorely try the loyalty of members to the Chair; but Mr. Ellery effaced himself to a degree that would have been almost dangerous in the case of a weak man. His reward was the despatch, with the utmost good humour, of an enormous bulk of business, some of it of a highly controversial character. Every paper was read, and all those that lent themselves to discussion were quite sufficiently discussed—no mean testimony to the real ability of the President.

The papers read at the meeting were, with hardly an exception, good, instructive, and eminently suitable. It would be invidious to attempt to forestall the judgment of the Council to the extent of indicating how these contributions appear to us to stand in order of merit. We venture to observe, however, that the papers of Mr. James Stelfox, Mr. Thomas Canning, Mr. Robert Hunter, and Mr. W. R. Chester will probably be read all the world over with keen appreciation by members of the fraternity of gas managers. The papers of Mr. Herbert Lees and Mr. Isaac Carr possess an interest of a different kind; but they are likely to be useful in their way, and will often be referred to in certain eventualities. The authors of all the papers were mindful of their audience, and kept to their point with a gratifying avoidance of padding. If we do not mention all their names, it is not for want of appreciation of their efforts. Never has the Institute had to rely less upon outside talent to provide *pabulum* for the members; and of several of the authors it can be truly said that their appearance in this new capacity is of the happiest augury

for the future of the Institute. The discussions were, moreover, as a rule, informing and suggestive; there being a pleasing rarity of the talkers for talking's sake, though the species was not without its exemplars. The lecture by Professor Lewes was in this accomplished master's best vein; and it not only proved a great attraction, but sent away those who had the pleasure of hearing it, with several things to think over at their leisure. Professor Lewes has never done anything better, or better worth doing, before a gas engineering audience.

Altogether, therefore, the Bath meeting of the Institute is to be pronounced not only as a success in itself, but also as auguring a continuing usefulness in, and consequent acceptability of, the organization by gas managers of the United Kingdom. Mr. James Stelfox is the new President; and the next place of meeting will once more be Belfast. As the Senior Vice-President is Mr. S. Stewart, and it may be taken for granted that, all being well, the meeting for 1899 will be held in Greenock, this will postpone till the year 1900 the next meeting of the Institute in London. This appears to be looking a long way ahead; for who can predict what will happen in regard to the organization of the British gas industry by the end of the century? Suffice it to say, for the time being, that this year no British Gas Managers' Association has better justified its existence than the Institute. The Institute is not perfect, of course. Some of its defects are due to its parentage and history; and it is not easy to see how these are to be got rid of. On the other hand, there is no denying the fact that it is both a living and a working organization. This year's "Transactions" will be more than respectable—in quality and in quantity. If some of the accessories of the Institute meetings are still somewhat "free and easy," the absence of the "superior "person" from the whole thing is no small compensating advantage in the eyes of the average member, who does not relish being looked down upon—especially by those whom he does not esteem as being better than himself. The Institute happens besides to be extremely well managed at the present time. It is undesirable to go into details. It is enough that the Institute, for one cause and another, did very well indeed at Bath this year; and with institutions as in the case of men, "nothing succeeds "like success."

The International Congress on Technical Education.

While The Gas Institute was busily occupied in furthering the technical education of the followers of the gas industry, an International Congress on Technical Education in general was sitting in London at the rooms of the Society of Arts. This was a very grand affair in its way; the Duke of Devonshire being President in succession to M. Sagniat, the head of the Permanent Bureau of the Congress. His Grace delivered an address which, for him, was an extraordinarily long effort. He claimed for the Society of Arts that for nearly 150 years it has been engaged, with a varying measure of success, and with varying public appreciation and support, in the endeavour to create in this country a recognition of the practical value as well as of the scientific and artistic interest of the application to business of science and art. The Society has extended a welcome to the Congress, one of the principal objects of which is to disseminate information respecting the methods of technical instruction pursued in different countries. English people have only recently begun to appreciate what is meant by this description of public teaching; and there is widely prevalent among us a belief that this country is far behind others in the provision made for it. The Duke of Devonshire, while admitting that in all countries there are now signs of increasing interest in foreign methods of teaching, wisely observed that systems of education cannot be transferred ready-made from one country to another.

It is not often found that persons who have been exclusively trained under the educational system of one country do particularly well in another. The chief exception to this general rule is to be found in England itself, which, with a remarkable power of assimilation not possessed in an equal degree by any other country, has hitherto known how to appropriate the best results of educational movements when initiated elsewhere. Technical instruction is perhaps of all kinds of teaching most readily transferable from one country to another; but this can only be successfully accomplished when the receiving country enjoys freedom of individual experiment and application. Ours is such a country, happily for its scientific and industrial future. We have not, and probably never shall have, the elaborately organized technical instruction of Germany or France; but, on the other hand, we have not their cast-iron rigidity of method. What is wanted here is better means of instruction in matters that can be taught, without any sacrifice of the present liberty of those who must teach themselves. It is hardly necessary to point out that the latter is by far the most fruitful method of education; but it is also the most arduous.

The perfect system of national education would be one that should begin by creating habits of order and obedience, and teaching the expanding intelligence how to learn; proceeding afterwards to indicate and introduce what is worth learning. The present defect of our national system of elementary education is that it tends to instil into the minds of the rising generation the idea that the book-learning, which is really only of disciplinary and preparatory value, is an end in itself. It is the same when young people are taken on to study chemistry, which usually stands at the beginning of the next stage, or secondary education. The man who needs instruction in chemistry is the man who wants to learn the science as a guide to the proper performance of his own work in the world. It is not the possession of a pass certificate in chemistry that makes a chemist, but the doing of work into which chemistry enters. We all require to realize better the necessity of doing a thing as really constituting the knowledge of it.

It is gratifying to learn, from a paper contributed to the Congress, that Professor G. Lunge, of Zurich, is bold enough to declare that such information in chemistry and technology as can be imparted to adult workmen by means of night classes is likely to do more harm than good. He protested that it is a great waste of time and means to provide this superficial kind of instruction to tens of thousands of workmen, on the remote chance that one of them here and there might derive some real benefit from it. Professor Silvanus Thompson agreed that the popular modern way of giving shallow floods of technical instruction is not likely to do any good. He urged that it would be better to confine the available resources of instruction in narrower and deeper channels—say, by establishing monotechnical rather than polytechnical institutes at the centres of the great industries. A good many other sensible things were said at the Congress, the reported proceedings of which, as they are given in abstract in "The Times," are well worth perusing.

The Massachusetts Gas Commissioners on the Boston Explosion.

There has been sent to us a copy of the report of the Board of Gas and Electric Light Commissioners of Massachusetts, upon the causes of the disastrous gas explosion on March 4 at the corner of Tremont and Boylston Streets in the city of Boston. It will be remembered that on the 25th ult. we reviewed in these columns the finding of Judge Ely, of the Boston Municipal Court, in the same matter. This was to the effect that, while all parties concerned in carrying out the subway operations in connection with which the explosion occurred were guilty of negligence, the Boston Gas Company, as owners of the gas-pipes, were immediately responsible for the catastrophe. An independent inquiry into the circumstances was ordered to be undertaken by the Commissioners, who have not lost any time in reporting to the Senate and House of Representatives. The investigation lasted for 38 days; the parties implicated being represented by Counsel. Evidence was taken, extending to 4495 type-written pages, from which it would appear that the Commissioners have not succeeded in discovering any means of shortening proceedings of this character in which Counsel are engaged. We have looked into the report, which is not a long statement, in order to ascertain how far Judge Ely's conclusions are sustained or impeached. The advantage of clearness of description and argument are not on the side of the Commissioners as compared with the legal luminary; Judge Ely's account of the circumstances being more intelligible than that which is given in the present report. The Judge found that the mains which broke and allowed gas to escape were old and defective castings, having been cast in the horizontal position. The Commissioners in their report express this more feebly by stating that "with the exception noted "above"—the existence of a soft place in one pipe—"there

"were no defects noticed in any of these pipes beyond the "fact that they were of less weight than the present stan- "dard of the Boston Gaslight Company, and of unequal "thickness in different parts, being known as eccentric "castings." What is an eccentric casting? The euphemistic phrase is certainly unknown to us in this or any other connection, and is an irritating example of the use of a long word to mean something for which a plainer and shorter one would have been better and truer.

The main question, however, is: Who was responsible for the sad accident? It seems to have given the Commissioners great trouble to instruct themselves upon this point; and their command of the English language is hardly equal to the task of explaining intelligibly what they discovered. We are able to gather that the work of supporting the gas-mains uncovered in the course of the subway construction was done by the contractors without reference to the Gas Company. "No supervision of the "means employed to support the pipes or of the method "of caring for them after excavating was begun by the Con- "struction Company or of the relation of any bridging to "them was given or attempted by the Gas Company." After this breathless sentence, it is quite a relief to read in plain, unmistakable terms the grave conclusion that the "accident" happened because nobody concerned did his duty. The street authorities contributed to it by insisting upon some provisions in the interest of the traffic which made thorough ventilation of the underground workings difficult. Neither the highway authorities nor the subway contractors cared anything about the ventilation of these spaces. The policeman on fixed point duty above the excavation neglected to give warning of the existence of a leak for an hour and a half after he first smelt the gas, though this was so strong as to cause him considerable annoyance. The work in progress was not properly inspected, not a single foreman of the Construction Company having been near the job for four days previous to the explosion. The Gas Company had a sufficient force of experienced hands to look after street-main leaks of all kinds; but this particular leak was not properly attended to by reason of "an inexcusable lack of "discipline" and attention. It is asserted that the Gas Company all along failed to realize the gravity of the subway operations as regards their interference with the gas-distributing plant.

This was the finding of the majority of the Gas Commission, composed of Messrs. Forrest E. Barker and Morris Schaff. The third Commissioner, Mr. Chas. H. Gifford, sent in a minority report, which, while strongly condemning the Gas Company and all the other parties implicated, suggests that the Edison Electric Lighting Company were very near to being numbered among them. "Had it not been for the small length of pipe burnt out, "and the direct testimony given as to the record shown "by the sensitive automatic indicator, this Company "might have been in a very different position as to the "findings in this report. That a gas of such quality "and in such quantities can be generated by their under- "ground construction as to produce this explosion, was "clearly demonstrated." Mr. Gifford remarks that he only mentions this "to show that it is not always the Gas "Company that is to be criticized for apparent leaks of "gas." He agrees with his colleagues in the other parts of the report, which he admits is not a strong document. He declares that, while it is impossible to say, from the evidence offered, what was the direct cause of the explosion, the impression made on his mind was that "lack of "constant care on the part of all parties in interest was "possibly the cause." This is tantamount to an endorsement of Judge Ely's finding, without the point that knowledge of the law enabled the learned Judge to impart to his conclusions.

WATER AND SANITARY AFFAIRS.

In presiding last week over the half-yearly meeting of the Southwark and Vauxhall Water Company, Alderman Sir Henry E. Knight was able to congratulate the shareholders upon the prosperous condition of their undertaking, while at the same time assuring them that the Directors were by no means lying on a bed of roses. There was the necessity of being continually prepared to resist attack, so as to defend the property entrusted to their charge. The conduct of the County Council in bringing forward again this session the Purchase Bills which Parliament rejected last year, was criticized as simply prompted by a desire to heap expenses on the Water Companies. The chance of getting the Bills passed was certainly as remote as it well could be; and the entire proceeding was the more unreasonable, seeing that the Government stood pledged to deal with the question forthwith. Perhaps the ratepayers will not be entirely unmindful of the fact that the sword cuts both ways; and while the Companies have to pay their own costs, the rates are burdened to defray the expense incurred by the Council. The money actually wasted over the Water Question is absolutely monstrous. Law and parliamentary expenses are incurred on both sides; and the Council are expending the ratepayers' money not only in the promotion or opposition of Bills, but also in carrying out surveys, inquiries, and endless analyses. There is, in addition to this, an Imperial charge in the cost of Royal Commissions; and though the Council have no great fondness for investigations not conducted by themselves, the Commission of 1892, as well as that which is just about to enter on its career, must be considered as arising in a great measure out of the agitation and ferment emanating from Spring Gardens. We suppose the Council will plead that they are doing their best to find money for the war, by taxing the Companies up to the hilt. Sir Henry Knight complains of this growing burden, and so does the Chairman of every Metropolitan Water Company. Mr. F. Tendron, at the recent meeting of the Grand Junction Company, stated that the increase in the rates borne by that undertaking had been as much as £7800 in six years. "London" replies to this by saying that the Company have no reason to complain, seeing that their annual receipts increased in the same period by as much as £22,000. But our contemporary omits to mention that, in order to gain this additional revenue, the Grand Junction Company had to extend their works and increase their capital, so as to bring upon them extra charges to the extent of £20,000 per annum, including rates and other items. Thus the net gain becomes only about £2000 per annum, in place of £22,000; and a very little turn of the scale might have thrown the balance the other way.

That the Metropolitan Water Companies are in a prosperous condition, is in nowise due to the fostering care of Parliament, though we are glad to recognize some signs of a more enlightened and equitable policy on the part of the Legislature within a recent period. Sir Henry Knight denounces as an "iniquitous Bill" the measure which Mr. Torrens brought into Parliament some years back, and but for which the Company would long ago have received their full statutory dividend. In declaring that "annual "value" should mean "rateable value" in the case of tenements supplied with water, the Legislature played tricks with the English language, at the same time showing that this was intended as a blow against the London Companies, by limiting the operation of the Act to the Metropolis. Sir Henry Knight is afraid that the operation of Mr. Chaplin's Metropolis Water Bill, should it pass into law, will expose the Companies to considerable loss as well as worry. It is suggested that a "very dangerous "power" will be given to the Local Authorities, by enabling them to pay the expenses of parties complaining against the Companies. To invoke the Railway and Canal Commission as a tribunal to settle such matters seems rather like bringing a Nasmyth hammer to crack a nut; and the London Water Companies may reasonably fear that considerable expense will be thrown upon them in connection with such proceedings. As for the Southwark and Vauxhall Company's Bill, we have already expressed our views respecting it; and we share the hope so confidently expressed by the Chairman that Parliament will approve the measure. Its rejection, if that were possible, would be a serious blunder, involving risk of a positive calamity.

With respect to the Royal Commission, it will be observed that Sir W. H. Wyatt, at the half-yearly meeting of the Chelsea Company last Thursday, expressed a fear that "some trouble" was awaiting the Company in consequence. Still we think it must be acknowledged that, both in the interest of the Companies and of the public, the appointment of the Commission puts the Water Question on the best footing that can be given to it at the present time. Some kind of conflict seems always to await the London Water Companies; and the Royal Commission may be accepted as one of the lesser evils.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-FOURTH ANNUAL GENERAL MEETING,

HELD AT

THE GUILDHALL, BATH, JUNE 15, 16, AND 17, 1897.

C. STAFFORD ELLERY, Esq., Assoc.M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THE fine old city of Bath looked its fairest in the bright sunshine of last Tuesday morning, when the members and friends of The Gas Institute assembled in the Guildhall in respectable, if not in overwhelming, force for this year's meeting. Mr. C. Stafford Ellery, the President, was in the chair; and his first words gave pleasing earnest, which was subsequently fulfilled, of his possessing in a high degree those qualities of promptness and incisiveness which are so essential to the transaction of the duties of the position.

The meeting was held in a beautiful and in every way convenient room, recalling by its chaste, yet rich decoration, the palmy days of Bath under the Regency. The acoustic qualities of the apartment left little to be desired; while the subsidiary arrangements for the comfort of those attending the meetings were perfect. Altogether, it may be said that the "setting" of the meeting was admirable in every respect.

The Mayor of Bath—Mr. George Woodiwiss, J.P.—attended, wearing his chain of office, to welcome the Institute to the city; and he performed this act of now familiar courtesy with a heartiness that deprived the function of all formality. Due acknowledgment of his Worship's friendliness was made on behalf of the Institute by Mr. J. Stelfox, of Belfast, and Mr. W. R. Chester, of Nottingham. A few words of welcome were also offered by the Chairman of the Bath Gas Company, Alderman Commans, whose kindly and appreciative references to the President, in his capacity of Engineer to the Company, awoke a sympathetic chord in the audience.

After these gracious formalities had been swiftly disposed of, the President invited the co-operation of the members in despatching a congratulatory telegram to the Queen, upon the Record Reign—an act of special significance and self-abnegating loyalty, seeing how severely the Jubilee duties of members militated against participation in the proceedings of the meeting.

The Birmingham Medal was awarded, with acclamation, to Dr. Auer von Welsbach, for his service to the gas industry in the invention of the incandescent gas-burner. Unfortunately, the celebrated medallist was unable to be present to receive his new distinction in person. The President's Medal and first premium were given to Mr. A. Dougall, of Tunbridge Wells; and the other prizes to Messrs. Holliday and Dexter.

Twenty-five minutes after the hour fixed for the opening of the meeting, the President was able to commence the reading of his Inaugural Address, the text of which we published last week. As in duty bound, he began with a reference to the Diamond Jubilee, the particular interest of which to the Institute might be expressed succinctly in the word "illuminations." From this he passed to reflect that it is twenty years since the Institute in its older form was last seen in the West of England; and a good deal has happened since then. With great prudence, however, Mr. Ellery did not proceed any further in the reminiscence vein, but was content to welcome the Institute to Bath in a courtly fashion that irresistibly recalled the grand manner of the immortal Master of the Ceremonies who received Mr. Pickwick, and is probably traditional in the locality. The Institute learnt a good deal about Bath, as it appears from the gas manager's point of view, before the President turned to more general topics. Thus the meeting was told how the district is "singularly hilly," though a carping critic might object to this description that the hills are distinctly in the plural. Mr. Ellery had something practical to say about regulating the gas pressure in districts of this character; and he has very wisely arrived at the conclusion that it is a mistake to cut the pressure too fine, either by day or by night. He confesses to being strongly of opinion that it is better to maintain the pipes in good condition, and give the consumers all the pressure they are likely to need, than to introduce a complication of governors and valves with the single object of preventing leakage. This is a judgment that can be unreservedly endorsed by most modern gas managers. Moreover, in localities where the unregulated burner is apt to proclaim its extravagance by roaring aloud, it is comparatively easy to convince the consumers of the advantages of using governor-burners. Mr. Ellery's ideal is, naturally, to equalize the day and night consumption in his district; and he is able to show that good progress has been made of late years in this direction.

Bath being a hilly city, it has its low levels as well as its high points; and the gas-works are situated in what used to be regarded as the ideal location for such factories—that is to say, in a deep hole down by the river. We took occasion to remark on a certain occasion—to be precise, it was during the floods of November, 1894—that Mr. Ellery must just then have wished gas plant was something made of iron, and situated on the top of a hill. He has got the iron plant, as he mentioned later on; but he also made his troubles of 1894 serve as the text for not the least amusing part of his address. To be drowned out twice in one week is a trying experience for any retort-settings. But those of Bath had to endure it; and, what is more, they seem to have stood it wonderfully well. One would have thought that a sudden irruption of flood water into a retort-house to a height of half way up the bottom retorts would have split everything into pieces; but it was not so. These retort-benches must have been well put together, and of first-class materials.

The President could not, of course, pass over the local electric lighting without mention; and some of the mordant humour which is seldom left out of Mr. Ellery's public remarks was spent upon the accident of a short-circuit which made a hole in a gas-service and ignited the escaping gas—fortunately, on the right side of the meter for the Company. Comment was offered, not unjustifiably, on the remarkable leniency of local authorities towards electric lights, as regards illuminating power. While gas is tested with the utmost rigour, nobody asks if a nominally 16-candle incandescent electric lamp is really giving this amount of light; while the arc lamp is notoriously a chartered libertine. This is not fair, of course; but, then, fairness was never the way of the world. What is "sauce for the goose" ought theoretically to be, but never is, "sauce for the gander" likewise. The President's local references were very appropriately brought to a conclusion by some remarks upon the highly diversified geological character of the district, which makes Bath intensely interesting to those fond of reading the "testimony of the rocks." He also hinted that some of his hearers might do worse than "take the waters;" judiciously refraining from offering any opinion as to whether the process had become more agreeable since Sam Weller tried the healing fluid, and found it "particklerly unpleasant."

The President's observations upon topics of general technical interest were characterized by extreme reserve, which rendered some part of his discourse almost colourless. Still, he made several additions to the existing stock of knowledge concerning carburetted water-gas manufacture. He refused to go into the carbonic oxide question; but he explained the effect of sending mixed gases through the mains, and showed how the mixed-gas flame interferes with the operation of the Methven standard. It is reassuring to know that, in Mr. Ellery's opinion, the fresh demand upon the oil supply is not likely to put up the price—which is a confirmation of our own expressed views on the subject. The address did not contain so much information in regard to the speaker's experience of tar carbonizing as was to have been expected. Indeed, but for a single brief passage, none of the President's hearers would have been made aware that, as a matter of fact, the experimental carbonization of part of the tar produced has been going on at the Bath Gas-Works for some years. What is now actually done is to mix the tar from the hydraulic main and the carburetted water-gas plant with the coal on its way to the retorts. By this means it is claimed that the yield and quality of the gas are improved, while the residual tar, curiously enough, is not greatly reduced in quantity or value.

The address contained a useful table of the comparative illuminating duty derivable from coal treated under different conditions, which will serve for reference. A few cursory observations and reflections upon the prepayment meter, the use of gas for power purposes, and Sunday labour in gas-works, proved greatly to the taste of the audience, who warmly applauded the President at the close of his reading.

The address was followed by Mr. Stelfox's capital paper on the Claus purification experiment at Belfast, the full story of which had never before been told. Mr. Stelfox is a tower of strength to the Institute, to which he has contributed some of the most valuable pieces of modern technical literature in existence. His present paper was quite up to his best form; and no other commendation of it will be needed by our readers. Of the same useful class was Mr. Robert Hunter's paper on the working of the Gadd and Mason gasholder at Chester. These plain, unvarnished records of experience constitute most valuable aids to progress. We shall not attempt to discuss here the papers read at the meeting.

Professor Lewes's lecture on Wednesday morning was of the nature of a triumph. Those who may have feared lest "custom" should have "staled" the facile lecturer's material or manner, were agreeably reassured by the style in which he set about his masterly demonstration of the truth concerning the action of the Bunsen burner. The two chief points of the lecture were the establishment of the importance of this truth in connection with the development of the illuminating effect of incandescent gas-burners; and the prospects of improving the manufacture of water gas opened up by Dellwik's new process. If the lecture was hardly "epoch-making," to use a much hackneyed phrase, it was of quite sufficient importance to lend distinction to the meeting which served to evoke it.

The remainder of the Wednesday morning sitting was given up to disquisitions upon naphthalene—a topic that generally comes to the fore where gas managers "most do congregate." That the papers and discussions should have left the matter very much where it was before, is another pleasing characteristic of the subject. The suggestion was once more made that statistical information should be collected for an organized onslaught upon this indomitable enemy, or friend, of coal gas; but one has heard too many propositions of the kind to entertain the confident hope of this one coming to anything.

The afternoon was pleasantly and profitably occupied with visits to the gas-works, and to the local engineering establishment of Messrs. Stothert and Pitt. At the gas-works, the President exhibited and explained his carburetted water-gas plant, which at the time was making gas to the extent of more than 50 per cent. of the total output of the works. Owing to local circumstances, the carburetted water gas is made here of an average illuminating power of 16½ candles, or about the same quality as the coal gas, than which it is a little cheaper to produce. Hence the new gas is depended upon for manufacturing in bulk, and not at all for enriching purposes. The quality named—16½ candles—is made with 2½ gallons of oil per 1000 cubic feet. The other speciality of the establishment is the arrangement for carbonizing a proportion of the tar. The tar as separated from the hydraulic main is pumped at once into an overhead cistern; and the outlet is so disposed that as the coal is being elevated into the hopper of the West's charging machinery, a tappet-valve allows a regulated quantity of tar to escape, and fall upon the contents of the coal-bucket. The dose is, of course, small; and the coal, which is usually dusty, readily takes it up without making any further mess. Although declining to commit himself to final figures, Mr. Ellery is satisfied that the process pays. There was installed at the head office an interesting novelty of which more is likely to be heard. This was Padfield and Settle's electrical recorder, which indicates and registers the state of the station meter, the height of gasholders, and any similar facts of working of which the Engineer may desire to be kept informed. One of these instruments has been in use for some months at Exeter, indicating in the Engineer's office the state of the station meter at the works.

The Mayor's *conversazione* was held on Wednesday evening, and was very well attended by members and friends of the Institute and leading citizens of Bath. All the rooms of the municipal building were thrown open; the handsome decorations and appointments arousing unstinted admiration. There is no municipal edifice in the kingdom that surpasses the Bath Guildhall and its annexes in convenience or elegance; but, unhappily, the good sense and taste manifested here only serves to throw into darker shadow the barbarism that is actually being exhibited by the Corporation in the conversion of the ruins of the Roman Bath into a "winter garden" by the aid of brand-new stonework, rolled girders, concrete arches, white glazed bricks, and the other familiar elements of the Earl's Court or Olympia order of architecture.

On Thursday, the first paper taken was Mr. W. R. Chester's description of Mr. William Cowan's latest invention for the automatic regulation of pressure in gas distributing mains. In his Inaugural Address last year, Mr. Chester referred with approval to an invention, which, as our readers may remember, had been described in two articles published in the "JOURNAL" on May 16 and July 11, 1893.* The approval then expressed has since been fully justified by practical results which are set forth in the paper, which will appear in a subsequent issue. Meantime, from the facts Mr. Chester records, as well as from his deductions from them, it may be safely inferred that an important advance has been made in the direction indicated. Never before the period of this invention had it been found possible to maintain, against all variations in the demands of a district, a constant fixed pressure at any desired part of it. But as the paper clearly shows, this result has been attained by the means described therein. Most of our readers have doubtless heard of proposals to regulate the district pressure more or less automatically. It has, of course, always been possible, by running water into a tank on the governor bell, in proportion to the bell's descent, to raise the pressure thereby; and many methods have been devised for this purpose. But none of these plans has ever secured more than a very limited degree of attention, while most of them have disappeared very soon after their introduction. One reason for this has been that all loading which depends for its degree on the position of the bell, necessarily deprives the governor of its function as an automatic maintainer of pressure, irrespective of the volume of gas passing through it. When a governor is so treated, it becomes a mere changer of the pressure which it is its chief duty to maintain. In such a case, extra demand is apt to be met not merely by increased volume, but by a supply at a higher pressure than is at the time necessary, and therefore excessive. So long as a solution of the problem of complete automatic regulation of the district pressure was sought for in these ways, it was hopeless to look for a satisfactory result. But in Mr. Chester's paper, as in the two articles already referred to, a way is shown of automatically loading and unloading the governor which does not interfere in the slightest degree with its normal function. While calling attention to Mr. Chester's paper, we would suggest a perusal of the two articles which bear upon the subject, as these contain the views of the inventor of the system, and have received full confirmation when tested in actual practice. It may be added that at the meeting the general consensus of opinion was strongly in favour of the principle of automatic regulation of gas pressures in a district.

After this purely technical paper came two "fighting" papers on the practical aspects of the municipalization of gas undertakings, by Mr. Isaac Carr and Mr. Herbert Lees respectively. It was the first time the subject had been so boldly opened up before a gas managers' gathering; and the result must be regarded as very satisfactory. A considerable mass of controversial literature has thus been condensed, and its essence concentrated in a form that will be found useful on future occasions. The discussion was lively, and much to the point. Mr. Canning's paper on "Gas Distribution in Relation to Modern Municipal Development" was taken on Thursday afternoon.

Afterwards, the remaining formal business was quickly despatched. The report of the Scrutineers showed that Mr. Stelfox had been unanimously elected President for the ensuing year—an announcement which was received with acclamation by the meeting. On the question of the next place of meeting, Mr. Chester suggested that the custom of alternating country with London meetings should be varied, and that the next year's gathering should be in Belfast, which would incidentally postpone the next ordinary London meeting until 1900. The suggestion was very popular, and was adopted by acclamation.

* See Vol. LXI., p. 886; Vol. LXII., p. 82.

The usual vote of thanks to the municipal hosts of the Institute was moved by Mr. W. Carr, and was passed with the heartiness which the hospitality of the Mayor and Mayoress and the Corporation unquestionably deserved.

The excursion to Longleat, the seat of the Marquis of Bath, was carried out on Friday as arranged, and proved highly enjoyable to those able to participate in it.

REPORT OF PROCEEDINGS.

The Thirty-fourth Annual General Meeting of the Institute was held on Tuesday, Wednesday, and Thursday of last week, in the Guildhall, Bath, under the presidency of Mr. C. Stafford Ellery, Assoc.M.Inst.C.E.

A Welcome by the Mayor.

The Mayor of Bath (George Woodiwiss, Esq., J.P.) attended, wearing his chain of office, and offered a hearty welcome to the Institute. He said he felt sure the members would all admire the beauties of the place, as he did when he first came to it some ten years ago. But the longer he lived there, the more he appreciated them. He was very pleased to see that his fellow-citizen, Mr. Ellery, was this year President of the Institute; and he was sure he would do everything possible to make the meeting a success.

Mr. J. Stelfox (Belfast) moved a vote of thanks to the Mayor and Corporation for their kind reception, and more especially for providing such a magnificent hall for the meetings.

Mr. W. R. Chester (Nottingham) seconded the motion.

The President, in putting it, said he had been met in the most kindly and generous spirit from the time he first mentioned the matter of the meeting to the Mayor.

The motion was carried unanimously, and briefly acknowledged by his Worship.

Alderman R. D. Commans (Chairman of the Bath Gas Company) also offered a few words of welcome to the Institute, and in appreciation of the character and ability of the President. He said he was sure the members would enjoy their visit, and especially the excursion on Friday, when they would see a house which, in combination with the estate and site, was perhaps unequalled in England.

A vote of thanks was accorded to Alderman Commans, and duly acknowledged.

Congratulatory Telegrams.

The President said it had occurred to the Council that the Institute might like to send a telegram of congratulation to Her Majesty; and they had drafted the following:—

Members of Incorporated Gas Institute of the United Kingdom assembled in the Guildhall, Bath, at thirty-fourth annual meeting, offer loyal and dutiful congratulations to your Majesty on completion of sixtieth year of glorious and beneficent reign.—C. Stafford Ellery, President.

It was moved by Mr. W. W. Hutchinson (Barnsley), seconded by Mr. John West (Manchester), and carried unanimously, that the above telegram be sent.

A telegram of congratulation was also despatched to the Société Technique du Gaz en France, which was then in session in Paris. Later in the proceedings, a similar telegram was despatched to the German Association, then meeting at Leipsic.

Confirmation of Minutes.

The minutes of the last meeting were agreed to be taken as read, and were confirmed.

Appointment of Scrutineers.

Mr. R. G. Shadbolt (Grantham) and Mr. E. H. Millard (Durham) were appointed Scrutineers of the ballot-papers.

The Report and Accounts.

The Secretary (Mr. Walter T. Dunn) then read the report of the Council, which was summarized in the "Journal" for the 25th ult. (p. 1185).

On the motion of Mr. E. C. Riley (Swindon), seconded by Mr. H. Lees (Hexham), the report was unanimously adopted.

Mr. G. Tooley (Leeds) moved the adoption of the accounts.

Mr. West seconded the motion; and it was carried unanimously.

Awards of Premiums.

The presentation of the Birmingham Medal was deferred for a time; no representative of Dr. Auer von Welsbach being present.

The President then announced the awards of premiums for papers read at the last meeting, as follows:—

First Prize (with the President's Medal).—To Mr. Andrew Dougall, of Tunbridge Wells, for his paper on "The Popularization of Gas."

Second Prize.—To Mr. J. Holliday, of Scarborough, for his paper on "Gas-Engines as Economical Motors."

Third Prize.—To Mr. F. G. Dexter, of Winchester, for his paper on "A Season's Experience with Incandescent Public Lighting."

Mr. Dougall, in returning thanks, said he was happy to think that the importance of the subject of his paper had something to do with the award.

Neither Mr. Holliday nor Mr. Dexter was present at the time to receive his award.

President's Address.

The President then delivered his Inaugural Address, which was given in the "Journal" last week (p. 1344).

Mr. Isaac Carr (Widnes) proposed a vote of thanks to the President for his most interesting and racy address. He said he often felt surprised at the quantity of fresh matter which Presidents contrived to introduce year after year. But Mr. Ellery had shown that, by drawing upon his own personal experience, a man could always find something new; for no two men's experiences were exactly the same. He was personally much obliged for what the President had said respecting water gas, about which, no doubt, some discussion would arise, and perhaps also on some other points. But this only showed the usefulness of the address.

Mr. S. Y. Shoubridge (Sydenham) seconded the motion, which was carried by acclamation.

The President said he had no doubt portions of the address would arouse differences of opinion; and, if so, one of his objects would have been accomplished.

The Birmingham Medal.

The President said, Lieut.-Col. Ellis being now present, he would hand to him, on behalf of Dr. Carl Auer von Welsbach, the Birmingham Medal, which was founded to encourage the extension of the uses of coal gas, and was to be bestowed for originality in connection with the manufacture or application of gas. No one could challenge Dr. Welsbach's title to originality; and his reputation in connection with the use of gas was world-wide. In handing the medal to Colonel Ellis, he could only regret that Dr. Welsbach was not able to be with them; but they hoped that on some future occasion he would honour the Institute by his presence.

Lieut.-Col. Ellis, a Director of the Incandescent Gas-Light Company, Limited, having explained that it was impossible for Dr. Welsbach to leave his experimental work and make such a long journey on this occasion, said he had been desired by the Doctor to express his regret, and also the intense gratification he felt at having this honour conferred upon him. He considered that it was a mark of the approval of the most eminent men in the gas world, and that the previous recipients were men who had highly distinguished themselves in the profession. On the part of his co-Directors and himself, he might venture to say that Dr. Auer von Welsbach was eminently worthy of this recognition; his incandescent light having been an immense advantage to the whole of the civilized world. Considering how universally it was now in use, the inventor met with extraordinary difficulties on its first introduction into this country in 1884; and it was not really until Mr. Julius Moeller took charge of the business, that anything like success in a commercial sense was secured. Dr. Welsbach was the originator and sole producer of the incandescent light; and though hundreds of chemists had endeavoured to improve upon his system, up to the present no one had come near him.

Reading of Papers.

The reading of papers was then commenced. These and the lecture were taken in the following order:—

Tuesday.—(1) "Experiments with the Claus System of

Purification at Belfast." By J. STELFOX, of Belfast. (2) "On Cooking by the Aid of Gas, and the Ventilation of Kitchens." By WILLIAM SUGG, of London. (3) "Notes on the Construction, and Experience in the Working of the Gadd and Mason Spiral-Guided Holder at the Chester Gas-Works." By R. HUNTER, of Chester.

Wednesday.—(4) "The Theory of the Atmospheric Burner and its Influence upon Incandescent Gas Lighting." Lecture by Professor VIVIAN B. LEWES, F.I.C., &c. (5) "Naphthalene in Modern Gas Manufacture, and the Carburetting of Illuminating Gas." By WILLIAM YOUNG, of Peebles, and THOMAS GLOVER, of West Bromwich. (6) "Three Years' Use of Carburine as an Enricher." By J. DAVIS, of Gravesend.

Thursday.—(7) "The Automatic Regulation of Pressure in the Distributing Mains." By W. R. CHESTER, M.Inst.C.E., of Nottingham. (8) "The Taxation of Gas by Local Authorities." By ISAAC CARR, of Widnes. (9) "Is the Municipalization of Gas Undertakings Advantageous?" By HERBERT LEES, of Hexham. (10) "Gas Distribution in Relation to Modern Municipal Development." By T. CANNING, of Newport (Mon.).

We give to-day the lecture by Professor Lewes; and the papers, with the necessary illustrations and the reports of the discussions, will appear in subsequent issues.

REPORT OF THE SCRUTINEERS.

On Thurday afternoon, the result of the ballot for the election of office-bearers for the ensuing year was declared as follows:—

President.—J. Stelfox, of Belfast.

Vice-Presidents.—S. Stewart, of Greenock; E. H. Stevenson, of London.

New Members of Council.—C. Craven, of Dewsbury; W. Ford, of Stockton; J. Barton, of Peterborough; R. Porter, of Elland.

Auditors.—Alfred Lass, of London; T. H. Martin, of New Barnet.

Hon. Secretary.—A. Dougall, of Tunbridge Wells.

Benevolent Fund Committee.—T. Bower, West Hartlepool; P. Simpson, Rugby.

NEW MEMBERS.

It was announced that all the gentlemen whose names appear in the following list of applications for admission to the Institute had been approved, and would be duly enrolled; and the transference of two associate members to the class of members was sanctioned by the meeting.

Members.—Baker, H., Cockermouth; Bark, S. E., Sunbury-on-Thames; Bark, W. T., Tenterden; Bellhouse, J., Goole; Brearley, J. H., Longwood; Deans, R. L., Johnstone (N.B.); Fendick, W., Boxmoor; Fenwick, J. B., Retford; Fligg, M., Redcar; Griffith, P., London; Harman, E. A., Huddersfield; Hooton, R., Ashton-under-Lyne; Howell, E., Yeovil; Johnston, J., Workington; Jones, H. H., Margate; Kendrick, H., Stretford; Langlands, S. B., Coleraine; Livesey, D. T., East Grinstead; Lucking, J. S., Rhos; Malam, G., Dumfries; Maybury, H. P., Great Malvern; M'Crae, W., Dundee; Merrill, J., Gaythorn, Manchester; Morris, W. W., Maryport; Nakagawa, G., Tokio; O'Grady, J. J., Castlebar; Rann, J., Normanton; Riley, H. E., St. Austell; Senior, S., Idle; Severs, W., Wilmslow; Shepherd, H. C., Old Swindon; Silcox, J. H., Pembroke Dock; Slater, A. B. B., jun., Rhode Island (U.S.A.); Smith, W. E., Ayr; Swinburne, G., Melbourne; Thomas, J. M., Penryn; Travers, T. P., Cork; Waddom, T., Newcastle-on-Tyne; Williams, E., Conway; Wilson, A., Perth; Wright, T., Cottingham.

Associate Members.—Acland, S. J., Brynmawr; Bagshaw, A. H., Nottingham; Davies, H., Darwen; Hardy, H. J., Swadlincote; Martin, E. H., Barnet; Rhodes, A., Gaythorn, Manchester; Simmers, R. B., Ramsgate; Smith, J., Padiham; Wilson, W. R., Kendal.

Associates.—Broadway, J., Elland; Waller, B. B., London; Williams, J. D., Southport.

Transferences.—Associate Members to Members: H. B. Green, of Preston; A. E. Saville, of Colwyn Bay.

AN HONORARY MEMBER.

The PRESIDENT proposed the election of the President of the Société Technique du Gaz en France for the current year as an Honorary Member of the Institute.

Mr. T. CANNING seconded the proposition; and it was carried unanimously.

PLACE OF NEXT MEETING.

The PRESIDENT said, in the ordinary course of things, the Institute would meet next year in London; but he believed Mr. Chester had a proposition to make on this matter.

Mr. CHESTER said he would rather suggest than formally propose at present, that it would be a graceful compliment to their newly-elected President if they altered the usual custom, which was not quite invariable, and met next year in Belfast. (Applause.) He should not have liked to move a resolution to this effect unless he had thought there was a general consensus of opinion in its favour. But he had ascertained that such a decision would not be unwelcome to Mr. Stelfox; and as the applause of the members had indicated that they were generally in accord with the idea, he would move that the next meeting be held in Belfast. He might point out that in all probability Mr. Stewart, of Greenock, would be President for 1899, and the Institute might desire in that year to visit Scotland; and in 1900—being the completion of the century—they would perhaps all desire the meeting should be held in London, which would possibly be more appreciated after a few years' absence. All this, however, was matter for the future. He simply moved that the meeting of the Institute next year be held in Belfast.

Mr. E. D. SAPEY (Horsham) seconded the motion. He said he thought there was a very general desire that the next meeting should take place in Belfast. It was the least honour they could do to the President-Elect; and he was sure they would not regret it.

Mr. W. CARR (Stalybridge) supported the motion. He said they all knew how much Mr. Stelfox had done for the Institute as an ordinary member, and would be pleased to give him an opportunity of "spreading himself" in his own town. London could well spare them for another year or so.

Mr. H. WIMHURST (Sleaford) also supported the motion, which was carried unanimously.

Mr. STELFOX said this seemed a proper opportunity for him to heartily thank the members for the honour they had conferred upon him, which he felt very deeply. The only hesitancy he had was as to his capacity to fulfil the duties of the office; but as they were told last year that the greater part of the business was done by the Secretary, he had no doubt that the efficiency of that gentleman would make up for any shortcomings on his own part. He was very pleased at the decision just arrived at; for, when the Institute were in Belfast a few years ago, he felt a little trepidation about it—the hotel accommodation not being so good as in many places, and he not feeling sure that they would have such a brilliant reception as they had been accustomed to. But as the members seemed to have been satisfied with their visit on that occasion, he could assure them that they would be welcomed next year with at least equal cordiality. He was very grateful for the honour conferred upon him, and should do his best to fulfil his duties satisfactorily.

Mr. STEWART also thanked the members for his election as Vice-President, and said he would do all he could to assist Mr. Stelfox during the coming year. What would happen afterwards, time only could show.

VOTES OF THANKS.

Mr. W. CARR moved that the best thanks of the Institute be accorded to the Corporation of Bath, for their kindness in granting them the use of the Guildhall for the meetings; and also to his Worship the Mayor, and the Mayoress (Mr. and Mrs. George Woodiwiss), for their hospitality on the occasion of the reception to which the members were invited on Wednesday, as well as for the welcome extended to the members on the opening day. He remarked that a great deal had been said about the municipalization of gas-works; but there were certainly many features about municipal corporations for which the

Institute ought to feel grateful. They had been received in Bath in a manner which did great credit to the Corporation of the city, and more especially to its Chief Magistrate; and considering that the Corporation were not the owners of the gas-works, their hospitality was all the more marked. They had placed at the disposal of the Institute a magnificent suite of buildings, which enabled them to hold the meeting with a comfort which they could not secure in London at the present time. Unfortunately, there was not a Corporation in London—or not one which recognized the Institute; and they had to do the best they could. In the country, however, they had been very well received from time to time by various municipalities; but he did not think that they had ever been so handsomely received and so generously entertained as on the present occasion.

Mr. W. D. CHILD (Romford) seconded the motion; remarking that he was certain it would not be a mere matter of form, but a genuine expression of feeling on the part of the members.

The PRESIDENT, in putting the motion, said the Mayor had certainly laid himself out to make the meetings of the Institute a success; and he (Mr. Ellery) had already personally thanked him very warmly for his kindness.

The resolution was carried unanimously.

Mr. R. G. SHADBOLT (Grantham) proposed a vote of thanks to the authors of papers. He said he took it the chief object of papers at such meetings as the present was to evoke good discussions; and, if so, they had succeeded admirably.

Mr. R. PORTER (Elland), in seconding the motion, said both the papers and the discussions had been of a very high character; and their thanks were eminently due to the authors.

The PRESIDENT remarked that this year they had had three papers from gentlemen who had contributed for the first time to the "Transactions;" and he expressed the hope that this would be an encouragement to others to come forward and volunteer papers. He was sure there were many gentlemen who were working on certain lines that would furnish material for papers which would be of great interest and advantage to the Institute.

The motion was carried unanimously.

Mr. W. H. S. GENDALL (Bury) then moved a vote of thanks to the Scrutineers.

Mr. R. W. C. BEYNON (Torquay) seconded the motion; and it was carried.

Mr. W. HARDIE, jun. (North Shields), next moved a cordial vote of thanks to the Council, for their services during the past year. The Institute now had, he said, a very representative and very able Council, who were fully entitled to a hearty vote of thanks.

Mr. S. W. DURKIN (Southampton), in seconding the motion, expressed the hope that the Council next year would take into consideration a suggestion which he threw out some few years ago—viz., that they should hold a good long morning session, and then adjourn for the day, instead of having a broken-up session in the afternoon.

The PRESIDENT said the suggestion would certainly be considered.

The motion was then carried unanimously.

Mr. SHOUBRIDGE said they must all have admired the grace, ease, and dignity with which the President had conducted the business of the meetings; but they were not all aware of the amount of time and trouble he had devoted to the business of the Institute. They had also to thank him for the great pains he had taken to ensure that the meeting should be pleasant and satisfactory, and that their visit to Bath should be a memorable one. They all felt the President had worthily maintained the dignity of the Institute; and he had much pleasure in proposing that a hearty vote of thanks be accorded to him for his distinguished services during the past year.

Mr. STELFOX, in seconding the motion, said Mr. Ellery must have had a good deal of anxiety during the past year; but at its close he must feel great satisfaction in knowing that everything had passed off so pleasantly, and that a long programme had been got through without a hitch of any kind.

The resolution having been unanimously carried,

The PRESIDENT, in reply, said it had been a very pleasant year to him; but the climax had come at the meeting. He should always remember the uniform kindness he had received at the hands of the members, and also the sympathy and assistance of the Council, which had rendered his duties so easy.

Mr. H. TOBEY (Malton) next moved a vote of thanks to the Auditors.

Mr. F. G. DEXTER (Winchester) seconded the motion, and it was adopted.

The PRESIDENT then moved a vote of thanks to the Honorary Secretary (Mr. Dougall). He said he was always at his post doing splendid work for the Institute in the most indefatigable manner, as he (the President) was in a position to judge by the large number of letters he had received from him during the past year.

Mr. STEWART seconded the motion, which was unanimously agreed to.

Mr. DOUGALL, in responding, said that it was always a pleasant thing to be associated with a successful society; and they would all agree that during the past year the Institute had made very considerable progress. He was glad to see so many of the younger members of the profession joining their ranks. He could assure them that it was a great pleasure to him to do anything he could to advance the interests of the Institute, because he had invariably received so much kindness from the members, and they had always been so ready to co-operate in making the meeting a success. In carrying out the arrangements, a great deal of work devolved on the Secretary, Mr. Dunn, who had proved himself quite equal to the occasion. Probably no one except the President saw so much as he (Mr. Dougall) did of Mr. Dunn; and he consequently had much pleasure in proposing that a hearty vote of thanks be accorded to him.

Mr. WIMHURST seconded the motion; remarking that the work falling on the Secretary had never been carried out better than it was now.

After a few words by the PRESIDENT, in support of the motion, it was carried unanimously.

Mr. DUNN, in reply, said he was much gratified at the kind words which had fallen from the Honorary Secretary. He had worked as hard as he could; and he was very glad to find that his efforts were appreciated.

THE LECTURE.

THE THEORY OF THE ATMOSPHERIC BURNER,

AND

ITS INFLUENCE UPON INCANDESCENT GAS LIGHTING.

By VIVIAN B. LEWES, F.I.C., &c.,

Chief Gas Examiner to the Corporation of the City of London, Professor of Chemistry at the Royal Naval College, Greenwich.

In the historical researches which led to the discovery of the principle of the miner's safety-lamp, Sir Humphry Davy noticed that if ethylene or other gaseous hydrocarbon capable of burning with a luminous flame was allowed to escape from a jet placed a few inches below a piece of iron wire gauze, and was then ignited above the gauze, the flame was no longer luminous, and deposited no carbon upon substances held in it. As years passed by, and coal gas asserted its position, not only as an illuminant, but also to a limited extent for heating purposes, Davy's observation was remembered; and some clumsy attempts were made to utilize it in creating from coal gas a heating flame, which should be free from the drawback of blackening the vessels heated in it. For scientific work, these early burners were warmly welcomed, in spite of their many failings, because, bad as they were, they yet had many advantages over the spirit-lamp, charcoal-furnace, and oil-lamp upon which the chemist up to that time had been dependent.

It was at this epoch that Bunsen, the greatest of Heidelberg's great men, was planning and fitting those laboratories which have since then given so rich a harvest to the scientific world; and while considering the methods of heating which should be adopted on the working benches, his attention was called by one of his assistants—now Sir Henry Roscoe—to the then novel contrivance of a non-luminous gas-burner. Seeing at a glance the enormous convenience of such a source of heat, Bunsen brought his marvellous manipulative skill to bear upon the subject, and in a few weeks gave the world its "bunsen burner"—a burner which has done more for the gas industry in the

past decade than almost any discovery or invention connected with it, which has made coal gas possible and successful for fuel purposes, and has enabled it, in conjunction with the incandescent mantle, to hold its own against the threatened rivalry of the electric light.

The names of Davy, Bunsen, and Roscoe will always awaken in the mind a long list of the benefits which their labours have conferred upon the world; but, for practical utility, the simple "atmospheric burner" will always remain one of the most successful achievements to be placed to their credit. Starting from the simple forms left to us by Bunsen, the skilled craft of such masters of the trade as Fletcher has given us convenient modifications in form for endless uses; while the utilization of the atmospheric burner as the heat supply for the incandescent mantle has, during the last few years, given rise to many alterations and some improvements in producing the non-luminous flame in the most effective form.

Notwithstanding the enormous amount of work which has been done in this direction, and the universal employment of the atmospheric burner, there still exists a considerable amount of misconception as to the causes which lead to non-luminosity, and which govern its efficiency for the purposes for which it is employed. In Davy's original experiment with the wire gauze, and in the earlier forms of burner, it is manifest that it is the mixture of air with the coal gas before combustion takes place that causes the luminosity; while in the bunsen form of the burner, it is only necessary to close the air-supply holes to prove the same thing. This form of burner, in one or other of its modifications, is the one most commonly used for incandescent lighting; and the method by which the mixture of air with the gas before combustion is brought about is simplicity itself. A small jet or series of orifices discharge the coal gas into a small chamber surmounted by the upright burner-tube; and either the chamber or the base of the tube is perforated with an opening or openings in connection with the air. When the gas-tap is opened, the coal gas is discharged through the jet with a velocity which is dependent upon the pressure of the supply, and instead of escaping by the lateral holes, it rushes upwards, dragging with it some of the air in contact with the stream of gas; so that as the mixture of gas and air passes up the tube, the pressure at the base of the tube is decreased, and more air is sucked in through the lateral orifices to re-establish equilibrium, and the formation of the mixture in the tube goes on as long as the gas continues to flow.

It is evident that in this way the stream of gas acts similarly to the steam in a Giffard's injector, or the air in a lady's spray-bottle; and the chief difference between a good and a bad burner depends upon so regulating the size of the gas and air orifices as to bring about the required combustion at the top of the burner-tube. A glance round any large laboratory reveals the fact that this is by no means generally attained; some burners giving a large loose flame with a luminous tip that marks too large an excess of gas, while others burn fiercely, show a tendency to "roar," and after a time flash back down the tube and ignite the gas as it issues from the jet at the bottom—symptoms marking an excessive air supply. In order to check as far as possible the variations, which are to a certain extent dependent upon the pressure of the gas supply, a sliding ring is placed around the lateral air-holes; and this, being pierced with holes coinciding only in one position with those in the burner, can be used to diminish the volume of air by being moved round, and so forms a regulator.

Having now obtained a clear idea of the general construction of the burner, it will be well to see why the bunsen flame should be non-luminous. It is manifest, from the construction and use of the atmospheric burner, that the primary cause of its non-luminosity is the admixture of air with the coal gas before combustion; and the idea that this acted by the atmospheric oxygen burning up the hydrocarbons in the coal gas before they could decompose and so liberate carbon in the solid state by which its incandescence would emit light, was the universally accepted theory up to twenty years ago, and still is the one most generally held by the unscientific public, and even by many burner makers. Atmospheric air consisting mainly of a mixture of 79·1 per cent. of nitrogen with 20·9 per cent. of oxygen, and the inert nitrogen playing no part in the ordinary processes of combustion, it was natural that the idea should be accepted that it was the oxygen only which was responsible for the de-illumination of the flame; and it was not until Knapp and others showed that a gas-flame could have its luminosity destroyed by mixing the gas before combustion with such inert diluents as nitrogen, carbon dioxide, and steam, that the possibility of the nitrogen in air playing any part in rendering the atmospheric burner flame non-luminous was entertained.

Researches made by Blochmann, Landolt, Heumann, and others, showed clearly that nitrogen did play an important part in this action; and attempts have been made to determine the relative importance of the oxygen and nitrogen in the action which lead to non-luminosity. In these experiments, a bunsen fitted with two supply-pipes leading into the chamber at the foot of the upright tube was used; each pipe being connected with a small meter, which was from time to time checked with a standard meter, so that the flow of gas and air could be accurately regulated and measured. Working with this arrangement, the quantity of air necessary to render the flame non-luminous was first determined—6 volumes of gas required 13·5 volumes of air. Now, 13·5 volumes of air contain roughly 2·7 volumes of oxygen and 10·8 volumes of nitrogen. On passing coal gas and nitrogen through the burner, at the rate of 6 volumes of coal gas to 10·8 volumes of nitrogen, a flame was obtained which had only a faintly luminous tip; while on passing coal gas as before, at the rate of 6 volumes to 2·7 volumes of oxygen, a luminous flame is produced, which flashes back unless the tube is covered with fine wire gauze.

This experiment was repeated on the photometer, and it was found that a bunsen burning gas alone (5 cubic feet per hour) gave a light of 5·6-candle power; one burning 5 cubic feet of gas and 2·2 cubic feet of oxygen, 3·1-candle power; while one burning 5 cubic feet of gas and 9 cubic feet of nitrogen, gave a result which was not readable. It appeared from this experiment that the amount of oxygen in the volume of air necessary to destroy luminosity does less than one-half the work; and the effect of varying the amount of oxygen was then tried, with the following results:—

	Candle Power.
5 cub. ft. of gas alone gave	5·6
" " to 1·1 cub. ft. of oxygen	5·4
" " 1·5 " "	8·0
" " 2·2 " "	3·1 (gauze used)
" " 2·5 " "	0·0 "

The amount of nitrogen present in the volume of air required to render the flame non-luminous, as shown above, just fell short of the quantity necessary to bring about the same effect by dilution only; and in order to determine the volume required to entirely destroy luminosity, coal gas was burnt at the rate of 6·2 cubic feet per hour, and was supplied with pure nitrogen, which had to pass at the rate of 14·2 cubic feet per hour before all luminosity disappeared, or practically the same amount of nitrogen is required as of air.

1 vol. of gas required 2·30 vols. of nitrogen.
1 " " 2·27 " " air.

At first sight it seemed from this result as if the oxygen of the air really only acted in the same way as the nitrogen—as a diluent. But if this were so, then mixtures of oxygen and nitrogen, richer in oxygen than air, should only affect the luminosity to about the same extent as air. This was not the case, as is shown by the following results:—

Volumes of Varying Mixtures of Nitrogen and Oxygen Required to Render One Volume of Coal Gas Non-Luminous in a Bunsen Burner.

Gas.	Vol. of Mixture required.		Composition of Mixture. Nitrogen.		Oxygen.	Vol. of Oxygen Present in Amount Required.
1 vol. requires	2·30	of	1	to	nil	.. nil
1 "	2·30	"	5	"	1	.. 0·38
1 "	2·27	"	4	"	1	.. 0·45
1 "	2·02	"	3	"	1	.. 0·50
1 "	1·49	"	2	"	1	.. 0·50
1 "	1·00	"	1	"	1	.. 0·50
1 "	0·50	"	nil	"	1	.. 0·50

This set of experiments showed very beautifully that until the percentage of oxygen reached the amount present in the atmosphere, the diluting influence of the nitrogen was so strong that it prevented the oxygen having any practical effect in the destruction of the luminosity, but that as soon as the quantity of oxygen present had risen above 25 per cent. its activity had so far overcome the diluting influence of the nitrogen that the matter had ceased to exercise any retarding influence over it.

In almost every laboratory, it may be noticed that whereas most of the bunsens are burning with their normal blue noiseless combustion, some one or two are roaring, and burning with a sharply-defined green centre. Experiment shows that this is brought about by the gas-delivery jet having become partly stopped up, and that a far larger supply of air than is necessary to cause non-luminosity is being sucked in.

Ratio of Gas to Air in Blue and Green Non-Luminous Combustion.

Blue	1 vol. of gas to 2·27 of air.
Green	1 „ „ 3·37 „

The green centre shows, therefore, that a large excess of air is passing in; and such a flame is on the point of flashing back in the burner, and lighting at the bottom. In this case the kind of action taking place in the flame has undergone considerable reduction; the flame being fiercer and smaller than in the normal combustion. The change is due to the fact that the proportion of oxygen to coal gas in the mixture is such that the chemical activity of the oxygen is able to overcome the diluting and cooling action of the nitrogen, so that the latter has practically ceased to act.

The volume of the various gases required to render the bunsen flame non-luminous was carefully determined; the number being limited by having to use a wet meter for their measurement.

Volumes of Gases Required to Render One Volume of Coal Gas Non-Luminous.

1 vol. of gas	requires	0·50	vols. of oxygen
„	„	1·26	„ carbon dioxide
„	„	2·27	„ air
„	„	2·30	„ nitrogen
„	„	5·11	„ carbon monoxide
„	„	12·40	„ hydrogen

These figures show that a diluent which burns and increases the general temperature of the flame must be added in far greater quantity than an inert and non-combustible diluent such as nitrogen—a result fully borne out by experience.

Some observers have attributed the varying effects of diluents to the effect of density;* but the destruction of luminosity in a flame can be brought about by cooling as well as by dilution, as is well known in the experiment described by Heumann, who noticed that, if a luminous flame was made to spread itself out over a cold surface, luminosity was destroyed, but could be restored by heating the substance over which the flame was playing. From this it was evident that, if one diluent had the power of extracting more heat from the flame than another, it would be more active in reducing the luminosity, and a smaller quantity would be required to render the flame non-luminous. On comparing the specific heats of equal volumes of the diluents used in the last experiment, the reason for the small quantity of carbon dioxide required was at once seen.

Specific Heats of Equal Volume.

Oxygen	0·2405
Carbon dioxide	0·3307
Nitrogen	0·2370
Air	0·2374
Carbon monoxide	0·2370
Hydrogen	0·2359

If this be the true explanation, it should be easy to trace the action by the decrease in temperature of the flame when carbon dioxide is used to render it non-luminous.

The temperatures of the flames were determined by the Le Chatelier thermo-couple—every possible precaution being taken to render them comparable; and though this method has been severely criticized by Professor Smithells, it still remains the best at present at our disposal.

Temperature of Flame from Bunsen Burner, with a Consumption of 6 Cubic Feet of Gas per Hour.

Point in Flame.	Flame Rendered Non-Luminous by Air.	Nitrogen.	Carbon Dioxide.	Luminous Flame from Bunsen.
½ inch above burner	54°	30°	35°	135°
1½ inches above burner	175	111	70	421
Tip of inner cone	1000	444	393	913
Centre of outer cone	1533	999	770	1328
Side of outer cone level with tip of inner cone	1333	1236	970	1236

These results fully bore out the inferences derived from the behaviour of the flame in the former experiments. In the flames rendered non-luminous by diluents, the inner cone for the first 1½ inches is decidedly cooler than in the luminous flame, owing to the cooling action of the nitrogen or carbon dioxide; in the upper portion of the inner cone of the flame rendered non-luminous by air, however, the oxygen of the air is acting, and the temperature is therefore higher than in the luminous flame; while in both the hottest portion of the flame is almost half way between the tip of the inner and outer cones. In flames rendered non-luminous by inert diluents, this is not the case, as the full amount of air necessary for combustion only being obtained at the side and tip of the outer cone, these are the hottest points. The low temperature registered at the tip of a luminous flame is probably due to the impossibility of keeping that portion of the flame steady when the gas is burning from a bunsen with the air supply closed.

Experiments with a bunsen burning a mixture of air and coal gas in such proportions as to give the green inner cone showed that, although the excess of air caused a low temperature at the bottom of the inner cone, the increase in rapidity of oxidation due to excess of oxygen produced a rapid rise of temperature, and a hotter and smaller flame was the result.

	Blue Inner Cone.	Greenish Inner Cone.
Tip of inner cone	1090°	1575°
Centre of outer cone	1533	1630
Tip of outer cone	1175	1545
Side of outer cone level with the tip of inner cone	1333	1511

These experiments and the researches of Heumann show that oxidation, dilution, and cooling all help to bring about the destruction of luminosity in a bunsen flame.

In all these experiments, ordinary London coal gas, as supplied by the South Metropolitan Gas Company, was used; but in order to determine how dilution acted towards richer gases, the ordinary gas was enriched up to 24 candles with oil gas, and 43-candle oil gas was also used alone. These gases were then tested in the bunsen burner at a carefully regulated rate of flow with air, carbon dioxide, and nitrogen; and the following figures give the results:—

Amount of Diluent Required by One Volume of Gas to Render a Bunsen Flame Non-Luminous.

	Candle Power.	Air.	Nitrogen.	Carbon Dioxide.
Coal gas	16·3	2·27	2·30	1·26
Oil gas	24·0	5·38	4·20	2·29
„	43·0	7·86	4·71	3·12

These figures reveal the interesting fact that with a rich gas far less nitrogen than air is required to bring about loss of luminosity, on account of the high temperature produced by the combustion of the heavy hydrocarbons with the oxygen in the air. The effect of the inert diluents was also noticeable; as at the point of non-luminosity the flame separated itself ¾ inch from the mouth of the burner, and became very elongated. Either dilution, cooling, or oxidation will render a coal-gas flame non-luminous; and all act to a certain extent in the bunsen flame. But a very important difference exists between the first and last agents; as, when gas has been so diluted as to be rendered non-luminous in its combustion, heating the mixture immediately before combustion restores the luminosity, while if oxidation is the cause, heating has no effect.

As regards the chemical changes taking place in the bunsen flame, considerable work has been done by Blochmann, Smithells, and myself; and the main changes are far more simple than those to be found in the luminous flame. The gas employed in these experiments was found on analysis to contain—

Hydrogen	52·16
Unsaturated hydrocarbons	3·50
Saturated hydrocarbons	36·25
Carbon monoxide	3·63
Carbon dioxide	0·00
Nitrogen	4·10
Oxygen	0·31
Sulphuretted hydrogen	0·00
	100·00

Such a gas requires 5·5 times its own volume of air for its complete combustion.

In the blue non-luminous combustion of a bunsen burner, the ratio of air to gas is only 1 : 2·5—*i.e.*, rather less than half the amount necessary to complete combustion; while with the green inner cone of combustion, the ratio of air to gas is 3·37 : 1. It is manifest, therefore, that the bunsen flame gets from the mixture only roughly one-half the air necessary for its complete combustion—the other portion being obtained from the exterior of the flame during combustion. It is this burning of the gas constituents in two stages that gives the dual character to the flame; the inner cone being due to incomplete combustion at the expense of the previously admixed air, while the

* D. Waldie, "Phil. Mag.," 1838.

outer cone is formed by the combustion of the products of combustion from the inner cone at the expense of the oxygen from the outer air. That this is the case can be beautifully shown by the flame separator devised by Mr. Lewis T. Wright, and elaborated by Professor Smithells, as the two portions of the flame can by its means be widely separated. This dual action is practically completed when the ratio of air to gas is 3·37, and the green inner cone is produced; and taking gas of the composition used in these experiments, the action in the inner cone, when completed as far as the supply of oxygen will allow, would be—

Hydrogen.		Oxygen.		Water.
H_2	+	O	=	H_2O

Ethylene.		Oxygen.		Carbon Monoxide.		Water.		Hydrogen.
C_2H_4	+	O_3	=	$2CO$	+	H_2O	+	H_2

Methane.		Oxygen.		Carbon Monoxide.		Water.		Hydrogen.
CH_4	+	O_2	=	CO	+	H_2O	+	H_2

The gaseous mixture escaping to burn in the outer cone consists of carbon monoxide and hydrogen in nearly equal proportions, diluted with double the quantity of steam and the residual nitrogen from the air in the mixture. Besides carbon monoxide there is also always found a small quantity of carbon dioxide, probably due to the oxidation of some of the monoxide by the steam present. The gaseous mixture which has now to undergo combustion with oxygen from the external air has a composition approximating to—

Water vapour	16
Nitrogen	60
Carbon monoxide	9
Hydrogen	10
Carbon dioxide	5
	100

At first sight, it appears hardly possible that a mixture of this kind, containing less than 20 per cent. of combustible gas, should burn, much less produce the intense heat found in the outer zone of the bunsen when burning with a green inner zone. As Professor Smithells has pointed out, however, when the flame is burning under ordinary conditions, the outer zone is invariably hotter than the inner; and this is undoubtedly due to the heat from the inner zone of combustion being added to that produced in the outer. When the bunsen flame is burning quietly with a violet blue inner cone, the ratio of air to gas is only 2·5 to 1; and under these conditions, considerable quantities of methane are found escaping from the inner cone, and burning with the hydrogen and carbon monoxide in the outer. This action is at present causing considerable inconvenience with incandescent mantles.

With the extension of the use of incandescent mantles, several minor troubles, which in the early days of its introduction were thought but little of, have with its extended use become serious drawbacks. Perhaps the most important of these is the frequent carbonization of the top of the mantle, which not only cuts down the illuminating value to a serious extent, but also gives rise to products of incomplete decomposition. At first sight, the reason of this sooty deposit appears clearly manifest; and the observer at once concludes that insufficient air has been mingled with the gas before combustion to render the flame absolutely non-luminous at the tip. On the removal of the carbonized mantle, however, the flame is found to be absolutely non-luminous; and even when the greatest care is exercised in testing all burners to see that they are giving non-luminous flames, the trouble still occurs.

If a bunsen burner be constructed with a platinum tube instead of the ordinary brass one, and if the air supply be so arranged that it burns with a blue non-luminous flame, heating the tube through which the mixture of air and gas is passing renders the flame again luminous, though the luminosity is considerably less than the original luminosity which would be obtained from the gas; and that this is probably due to restoring heat to the flame, is shown by allowing the mixture to cool down before igniting it, when the non-luminous flame is again produced—showing that it really is simply the action of heat, and not any specific alteration in the composition of the gas. If, however, the bunsen flame is burning with a green inner cone, it is not possible to in this way again render the flame luminous. If, instead of taking a platinum tube, and heating it by means of a blowpipe, the blue non-luminous flame be surrounded with a mantle of platinum gauze open at the top, and so arranged that the sides of the flame impinge upon it in their passage through it, the mantle will quickly be heated to a high temperature; and the top of the flame, which before was non-luminous, will now become luminous—the platinum gauze acting as a superheater which gives sufficient heat to the flame to reach the point at which the diluted hydrocarbons escaping from the inner cone become decomposed with separation of carbon. If the platinum gauze be replaced by an ordinary mantle fabric open at the top, the same phenomenon will be observed; and it is this action which leads to the deposition of carbon on the upper portion of mantles.

It will be noticed that carbon often begins to deposit upon the rod acting as a central support to the mantle; this rod being fixed in a small plate in the centre of the burner. The plate really forms a baffle; and above it there is an area wherein there is simply some of the mixture of unburnt gas and air eddying around, which being highly heated by radiation from the walls of the mantle, yields conditions best fitted for the separation of carbon that may still exist in any unconsumed hydrocarbons. When once this carbon begins to form, its catalytic action upon any hydrocarbons still present causes the decomposition to increase in rapidity until both the rod and the upper portion of the mantle become coated to an extent which not only reduces to a minimum the light emitted, but gives rise to distinct traces of carbon monoxide in the products of combustion. This trouble can be avoided by arranging the burner so that the gas should draw in with it the maximum air supply, and should burn with nothing but a green inner cone; and when this limit has been reached (there being no hydrocarbons to be burnt up with decomposition in the outer flame), the carbonizing of the mantle ceases. I think that an outer suspending rod, and a burner which will allow of a mixture of the gas with a maximum amount of air being made without roaring, would entirely do away with this serious disadvantage.

It is manifest, from the results which I have brought before you, that it is imperative, in order to get a proper bunsen flame for incandescent mantles, that the air drawn in with the gas should be in the ratio of 1 of gas to 3·4 of air; while the ordinary burner, under normal conditions, yields a ratio of 1 to 2½. Moreover, one of the greatest mistakes which has been made with regard to mantle burners, is that the flame with the mantle has been considered as being the same as the flame without the mantle. A moment of consideration will show the fallacy of this. If a burner be arranged so as to give a satisfactory flame, the combustion will be carried on at the expense of about three-fifths of the total air required, which had been previously mixed with the gas, while at least two-fifths more have to be obtained from the air; and when the flame is burning unchecked and without a mantle, it obtains this without any trouble. On placing the mantle over the flame, however, the fine network gets rapidly heated to a high temperature, and the condition of the flame will be entirely altered; the inner zone of combustion, at the expense of the previously admixed air, continuing as before, while the products of this incomplete combustion have to find their way through the meshes of the mantle and to burn upon its surface, as the hot mantle will prevent the diffusion inwards of the necessary air to complete the combustion below its surface. In order, therefore, to obtain the necessary conditions for a good burner for this purpose, it is necessary to obtain a mixture richer in air before combustion than with the ordinary burner; and though this is easy to obtain when the gas is under high pressure, the problem offers considerable difficulties when there is only the ordinary town pressure to deal with.

In order to get the necessary maximum of air, the jet by which the gas enters the bottom of the burner must be made as perfect an injector as possible; and this can only be done by using a single aperture of conical form with the opening nicely regulated to the gas consumption required. A number of small apertures, as used in many burners, defeat the purpose for which they were intended. Moreover, the in drawing action of the stream of gas from the injector must be continuous over as long a space as possible; and this is best attained by allowing the gas to suck in the air at different stages in its upflow—a principle which has been adopted in the multiple cone burners made by Chemin and Bandsept—while the size and arrangement of these air orifices require most careful regulation, in order to obtain the desired ratio of gas and air.

Yet another point of great importance is to be found in the shape and circumference of the burner-head. It is

well known that, if an ordinary flat-flame burner be turned on and the gas be allowed to escape unconsumed, more gas will pass through the burner than if the gas be lighted; this being due to the expansion of the gas in the heated head of the burner throwing a back-pressure on the gas below. This same phenomenon is to be observed with an ordinary bunsen burner—*i.e.*, if the straight tube be used with a burner-head having the same superficial area as the tube itself, a slight back-pressure is created, which upsets the ratio of air drawn in by the gas injector. In order to overcome this, the burner-head should consist of an inverted cone, the dimensions of which are so arranged that as the mixture of gas and air ascends, the extra space shall be exactly equivalent to the expansion the mixture undergoes. Yet another point that is frequently overlooked is that, as the gas sucks in the air, the mixture formed in the tube is by no means perfect; and it will always be found that the mixture is richer in gas near the centre, and richer in air near the sides. This imperfect admixture is to a great extent overcome by the gradual introduction of the air in small portions. But it is important that in the mouth of the burner, immediately before combustion, there should be some arrangement by which perfect admixture is ensured; and it is only under conditions such as these that the best results can be attained.

The two burners which aim at producing perfect admixture of gas by these methods, are the Chemin and the Bandsept, in both of which successive cones are used. Whereas Bandsept realized the necessity of paying attention to the gas-injector and of the inverted cone at the head of the burner, Chemin uses a cone with its apex upwards—an arrangement which, instead of intensifying the uprush of the mixture, as he evidently expected it would, entirely upsets the whole behaviour of the burner; and there is no doubt that Bandsept, by embodying these various principles, and using several layers of wire gauze placed at the point immediately before combustion takes place, has given us by far the most valuable bunsen burner for mantle use that has yet been devised. I have made many experiments with this burner, and find that it gives with mantles of various makes a very high increase in efficiency, amounting in many cases to over 30 per cent.; while, to my great surprise, it seems to prolong rather than shorten the life of the mantle, and after 500 hours shows a far higher percentage gain than during the first few hours.

It will be fresh in the memory of some of the members of the Institute that, at the Edinburgh meeting two years ago, I showed a Denayrouze burner as it was then made, in which, by using a small electric motor, the gas and air were thoroughly churned together, and discharged in a complete state of admixture for combustion; the result being a very high duty from the mantle, and the doing away with the necessity for a chimney. It was found in practice, however, that the electric motor and shortening the life of the mantle were serious drawbacks to its use; and M. Denayrouze has since then brought out a burner specially adapted for high intensity lighting, in which the motor has been done away with. In this burner, with a pressure of 2½ inches, I have obtained, with the Welsbach mantles made for it, a light of 18 candles per cubic foot of gas consumed; no chimney being employed.

It will at once be said that this duty is so little above that to be obtained by the ordinary Welsbach, that the advantage is hardly worth the use of a special burner. But in the Denayrouze burner, the gas consumed, instead of being limited to 5 cubic feet, can be taken at a pressure of 2½ inches to 10 cubic feet; and the total light would therefore be 180 candles. When using a cluster of three of the burners, for a consumption of 27 cubic feet one obtains practically 500 candles; while as the number of burners in the cluster is increased, a small diminution in the service per cubic foot takes place, owing to the fact that the incandescent mantle is not transparent to light in the same way that a flame is, and therefore the larger the number of burners in the cluster the greater will be the loss of light due to this factor. If, however, the same effect were to be attempted with the ordinary Welsbach mantles, not only would the number of burners have to be very largely increased owing to the limit in the consumption of gas, but each mantle being fitted with a glass an enormous loss of light would ensue, owing to the loss of light entailed by their use. Several processes are also under consideration for the production of high-intensity lights by means of mechanical contrivances—increasing either the gas or the air pressure. Such high-intensity processes as those devised by Greyson de Schodt, Bandsept (the maker of the burner above referred to), and Caton give very intense lights. But my experiments with them not yet being complete, and the burners, owing to the artificial pressure, not being bunsen burners in the true sense of the word, I prefer to leave the discussion of these systems to a future occasion.

In dealing with the chemical action, I pointed out that the gas which burns on the surface of the mantle and gives it its power of light emission, was practically a mixture of equal volumes of carbon monoxide and hydrogen, diluted to a very great extent with residual nitrogen from the air. This at once suggests that water gas alone, burning without any admixture of air, would prove a highly successful method of generating light; and there is no doubt that, when water gas is consumed in a properly constructed burner, even more light can be obtained per cubic foot burnt with a mantle than with coal gas. In spite of the opposition which the idea has always met with in this country, I am perfectly convinced in my own mind that for street lighting water gas with incandescent mantles will be the light of the future—more especially as within the last few months some most remarkable strides have been made in the methods by which water gas is made. Though it will sound to many present like a fairy tale to speak of 77,000 cubic feet of water gas per ton of ordinary gas coke, yet it is a fact I have seen accomplished within the past month by a process introduced by Mr. Dellwik,* and which I have carefully tested on a large scale.

The ordinary process of making water gas consists in blowing a fairly deep bed of fuel with air until it is raised to incandescence, and then passing steam through it, when the latter is decomposed by the heated carbon with formation of carbon monoxide and hydrogen. This causes loss of heat; and after a short time the steam has to be cut off, and the fuel again raised to incandescence by the air-blast. In performing this cycle of operations, two gaseous mixtures are produced—(1) Producer gas, a mixture of carbon monoxide, carbon dioxide, and the residual nitrogen from the air, this being formed during the process of raising the temperature by the air-blast; and (2) water gas made during the process of steaming the incandescent fuel. Working under normal conditions, with an apparatus of the type generally employed, the composition of these gases is as follows:—

	Producer Gas.		Water Gas.
Nitrogen	63·64	..	2·87
Carbon monoxide	29·33	..	39·98
Carbon dioxide	4·15	..	5·61
Hydrogen	2·88	..	51·54
	100·00		100·00

It will be seen from these analyses, that the producer gas only contains 32 per cent. of combustible gas, and in many cases still less, with the result that it is so poor a fuel as to be hardly worth using except in such operations as making carburetted water gas by the Lowe process, where it is employed for raising the temperature of the superheater. In consequence of this, in nearly all cases the producer gas is blown to waste; and this entails an enormous waste of fuel. In ordinary practice, it may be taken that for every 1000 cubic feet of water gas made by the usual process from gas coke, 4000 cubic feet of producer gas must be made to revive the temperature of the fuel bed; while only 1000 cubic feet of water gas can then be made before the temperature falls to the point necessary for re-blasting. Now 1000 cubic feet of water gas contain 15·07 lbs. of carbon; while 4000 cubic feet of producer gas contain 44·2 lbs. It is manifest, therefore, that in round numbers 60 lbs. of carbon are used in order to make 1000 cubic feet of water gas; the result being that, with a coke containing 87 per cent. of carbon, it is only possible to make 32,480 cubic feet of water gas, and even with good coke the average would not exceed 34,000 cubic feet of water gas per ton.

When carbon is burnt to carbon monoxide, as in the ordinary water-gas process, each unit weight of carbon consumed yields 2400 heat units; while if the carbon be burnt so as to produce carbon dioxide, the heat evolved for the same quantity of carbon burnt is 8080 units, or 3·37 times as much. In other words, the same quantity

* Abstracts of several of this inventor's patent specifications have recently appeared in our pa es.—Ed. J.G.L.

of heat is developed for less than one-third the fuel; and instead of each 1000 cubic feet of water gas requiring the combustion of 44·2 lbs. of carbon to again raise the temperature of the coke in the generator to the required point, it would only take 83·1 lbs.—*i.e.*, it is possible to make 1000 cubic feet of water gas with a consumption of 25 to 28 lbs. of carbon. It is this principle that has been utilized in the Dellwik plant; and by the special arrangement of generator employed—in which the height of the fuel-bed is kept practically constant, and the air-blast introduced in such a way as to complete the combustion during the process of blowing—the entire system of water-gas making has been reversed, and instead of blowing for ten minutes and then steaming for from four to five minutes, as was done in the old procedure, they now blow from one to two minutes and steam for seven to ten minutes, according to the condition of the fuel. The coke used when I tested the plant yielded on analysis—

Carbon	87·56
Moisture	0·54
Ash	11·90
	100·00

The generator, having been filled to its full capacity, was worked continuously for 4½ hours, during which period the results were as follows:—

Gas made	19,119 c. ft.
Number of runs	20
Coke used in generator	4,664 lbs.
Average period of blowing	1¼ min.
" " " steaming	8 "

Ratio of gas to coke, 1000 cubic feet to 24·5 lbs.

To this must be added 20 per cent. more coke used in raising the necessary steam for generator and blower, which makes 1000 cubic feet to 29·3 lbs. The temperature of the gas in the pipe leading from the scrubber to the holder was 21° C. (69·8° Fahr.); but in the holder it was not appreciably above the air temperature. The clinker from the twenty runs amounted to 33 lbs., and was easily removed.

The value of water gas largely depends upon keeping the percentage of carbon dioxide as low as possible; and 5 per cent. in the unpurified gas may be looked upon as a fair average. But it is well known that the percentage rapidly increases as the temperature of the fuel falls; and it seemed highly probable that the prolonged steaming would yield a gas containing too large a volume of this impurity. In order to carefully check this point, five analyses of the carbon dioxide were taken during the runs, with the following results: 4·9, 4·2, 4·9, 4·6, 4·3—average, 4·58 per cent. Samples of gas from the holder were also taken at intervals during the process of making, and were afterwards analyzed; the results being as follows:—

	I.	II.	III.
Hydrogen	52·43	50·09	52·16
Carbon monoxide	38·30	39·95	37·50
Carbon dioxide	3·73	5·38	4·08
Oxygen	0·74	1·22	0·24
Nitrogen	3·81	2·77	5·21

For a crude gas, these results must be looked upon as very good.

I also carefully checked the actions that were going on during the process of blowing up the fuel to incandescence, in order to see if the actions claimed as giving rise to the great economy of fuel really took place. Two complete analyses of the "blow" gas were made, with the following results:—

	I.	II.
Carbon dioxide	17·9	18·8
Carbon monoxide	1·8	1·0
Nitrogen	78·6	79·5
Oxygen	1·7	0·7

While during the remaining blows, the carbon dioxide only was estimated, and yielded 18·6, 17·6, 18·6, 16·8, 17·7, 16·0, 15·1, 15·2, 17·4, 18·6, 16·1, 18·1, and 16·05 per cent. respectively.

In the ordinary water-gas manufacture, the ratio of carbon dioxide to carbon monoxide is about 1 to 7, while in the Dellwik process it is on the average about 12 to 1; showing clearly that the complete combustion claimed by the inventor does in reality take place.

Even with the enormous drawback of making some 4000 cubic feet of useless producer gas for each 1000 feet of water gas, the old process proved itself a success where intense temperatures have been required—as in the welding of boiler-flues, &c.; and Dellwik's discovery, by which the practically valueless producer gas is done away with, should be of very great commercial value.

One thousand cubic feet of water gas, containing 15 lbs. of carbon, are obtained by a total expenditure of 29 lbs. of carbon; so that over 51 per cent. of the carbon is obtained in the gaseous form, while the expenditure of the other 49 per cent. results in the hydrogen of the water gas.

The coke used in the experiments made contained 87·56 per cent. of carbon, or 1961·3 lbs. per ton—equal to 15,846,304 thermal units (°C.); and this amount yielded 77,241 cubic feet of water gas. The specific gravity of the water gas, as taken by the Lux balance, was ·5365; and its gross calorific value, as determined in Junker's calorimeter, was 4089 thermal units. Hence the calorific value of the water gas from a ton of coke was 13,033,059·8 thermal units, or over 82 per cent. of the heating value of the total coke used in both generator and boiler.

From this calculation, 20 per cent. of the coke has been taken as used for raising steam; but in a large installation, this figure could be reduced, and the percentage of the total heating value of the coke obtained in the gas slightly raised. The labour needed will be less than with the ordinary process, as less fuel has to be handled.

During the next decade we shall probably see many new and startling improvements in the generation of light; but it will indeed be a red-letter day in the history of commercial success if a combination more important than the bunsen burner and the incandescent mantle are pressed into improved work and giving us more light.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

THE process of quieting down ready for the Jubilee has proceeded in the Stock Markets as in all others, except those dealing in the necessaries of the moment. From the commencement of the past week, every department was very idle; and the general tendency was flat. There was a disposition to close accounts before the great festival; and therefore markets were inclined to be flat. Perhaps at any other time the sudden death of so conspicuous a figure in financial circles as Mr. Barnato would have had a stronger effect on prices. As it was, very little movement was produced in the South African market, beyond a slight depression at first, which was soon afterwards effaced. The Money Market offers no feature beyond that which is normal at the close of the half year. The Gas Market has, of course, been quiet like all the rest; but it was scarcely any quieter than it was in the preceding week. Good uniform steadiness was the characteristic; quotations not being changed at all. Everything appeared to be just marking time till the holiday break is over; and then it is hoped they will march on at quick step. In Gaslights, there was a fair amount done, all things considered; and the price held pretty firm, though without any disposition to improve. The secured issues too were not neglected; and they changed hands at good medium figures. South Metropolitan was very steady, though on Monday the quotation was lowered a point. This appeared a mistake, as the actual price realized showed no falling off, but rather the reverse; and the quotation was put back again the next day. Nothing was done in Commercials; and next to nothing in the Suburban and Provincial division. In the Continental group, continued firmness was apparent in Imperial, which changed hands at slightly better figures. None of the rest offered any feature calling for remark. Business in the Water Companies was quiet, and not remarkable; but they had the distinction of furnishing the only change of quotation noted throughout the list—New River rising a couple of points.

The daily operations do not call for special notice in detail, as no variation in value was produced; and the position of all stocks is practically the same as they occupied a week ago. In view of this, it is unnecessary to give our usual list of prices at the end of "Miscellaneous News." As mentioned above, there were no changes in Gas; and in Water the only movement was the rise of 2 in New River shares—making the closing price 425-30, and yielding upon the investment £3 os. 4d. per cent. The next dividend on Southwark and Vauxhall ordinary and 7½ per cent. maximum is to be at the rate of 5 per cent.—returning to the investor at the present market price £3 os. 7d. and £3 4s. 6d. respectively.

THE GAS SECTION OF THE VICTORIAN EXHIBITION AT THE CRYSTAL PALACE.

NOTWITHSTANDING the tremendous growth in the consumption of gas during the past few years, and the efforts that have been made to educate both consumers and householders, there still abounds, as every interested person knows, a vast amount of

ignorance concerning the most advantageous methods of using gas, and the numerous appliances that have been devised for applying it to domestic and other purposes. Therefore gas suppliers must, in their own interests, avail themselves of every opportunity of disseminating knowledge on the subject. This year of rejoicing will be marked by much festivity; and gas managers should seize every possible occasion to fit up, even if temporarily and at the cost of their companies or authorities, the places for entertainment with examples of the latest systems of lighting, and in some instances arrangements might even be made to provide stoves to prove what can be done in the way of cooking by gas.

One of the opportunities which has offered itself for showing some of the latest improvements in the use of gas for lighting, heating, and cooking is the Victorian Exhibition now being held at the Crystal Palace; and certainly the exhibition would not have been perfect had gas appliances not been granted a place. At the time of the opening, in May, we were unable to do more than announce the fact that there would be a section devoted to gas lighting and heating, as, for divers reasons, the preparations for the accommodation of the exhibits were delayed in favour of those sections which occupy more prominent positions in the Palace. But in being thus belated, gas did not stand alone; its companion in adversity being electricity, which even now cannot do more than show visitors the elaborate structures which are being erected for the display of its apparatus. However, since the end of May, much energy has been displayed in bringing the Gas Section to an attractive and representative condition; and now there is to be seen an array of lighting, cooking, and heating appliances of which the gas industry need not be ashamed. This is due in a great measure to the interest shown in the matter by the management of the South Metropolitan Gas Company, whose Chief Inspector (Mr. Charles Howard) has devoted much time to the supervision of the arrangements. Now—with the exception of one or two outside stands—the gas exhibits have been left in charge of Mr. Slater, the Company's Inspector of gas-stoves, &c.; and he is in constant attendance. There is something novel in this plan of having an independent and unbiassed custodian of a sectional exhibition of this kind; and visitors will appreciate the freedom from the clamour of competing trade representatives, as well as the knowledge to be gained by a chat with a courteous and well-informed attendant, who has no interest to serve beyond enlightening visitors as to the salient features of the various appliances on view. There is one complaint to make in regard to this particular section, and it is that (through no fault of the organizers) it occupies one of the most secluded positions in the Palace—indeed, it is hemmed in on three sides by walls without passage, and on the fourth the electrical stalls almost hide all indication of what lies beyond. We believe, however, steps are being taken to try to obtain another entrance into the section; and a few bills placed in prominent positions, directing visitors to the section, would no doubt have a beneficial effect.

With regard to the exhibits, it is in these pages unnecessary to do much more than mention the names of the manufacturers for readers to judge of the class of goods on view. In nearly every case, the firms occupy separate stands; and we will deal with them here in the order in which they were inspected. First there is a stand which has been furnished by the South Metropolitan Gas Company; and it contains many interesting objects. Among them are models illustrating the development of gas engineering from the early days of the industry; but these and other historical exhibits will be described in a special article in a subsequent number of the "JOURNAL." A model of West's charging and drawing machinery is shown. Specimens of coal and cannel used in, and sulphur and other products obtained from, the manufacture of gas are accorded a place. Here is also a portable recording gas-pressure gauge, manufactured by Messrs. Parker and Lester. It is claimed that this instrument is most sensitive and reliable; and as no liquid is used in its construction, the inconveniences attending liquid gauges are obviated. One of Messrs. Willey and Co.'s prepayment meters is also on view. Another appliance for employment in connection with incandescent gas lighting is a bye-pass cock which has been patented by the South Metropolitan Gas Company, and is largely used in their district. Opposite is a stand on which are shown numerous examples of the products and aniline dyes extracted from coal. These have been lent by the well-known firm of Messrs. Forbes, Abbott, and Lennard; and the brilliant colours form a conspicuous feature. The foot of this stand has been found a convenient spot for a wooden water-pipe of a past age; and it has been remarkably well preserved. Messrs. R. and A. Main make a good display of their gas fires, ovens, cookers, grillers, &c.; and the same may be said of the Davis Gas-Stove Company, Limited. Ranged along the front of the stand of the latter are a number of "Holophane" globes of several patterns; and when at night time the jets and incandescent mantles in them are alight simultaneously, the illumination is almost dazzling. The manufactures of Messrs. W. Parkinson and Co. occupy the next stand—the principal features being their cooking ranges, fires, and meters. At a neighbouring stand, Mr. S. Beal, of the South Metropolitan Metal-Works, shows some of his specialities, such as high and low pressure valves, cocks for gas, water, and steam, various fittings, gauges, pumps, &c. Next come Messrs. Richmond and Co., Limited, with a collection of the numerous appliances which they manufacture for cooking and heating purposes; and their stand is followed by one on which is an interesting display of Messrs. W. and B. Cowan's governors, pressure-gauges, meters, &c. A small but attractive stand is that of Messrs. Sawer and Purves, on which is to be seen their "Positive" prepayment meter, taps, valves, unions, gauges, and other articles. Improved and artistic fittings for private and public lighting are on view at the stand of Messrs. Greene and Sons; and a notable feature of their exhibits is the "Vertmarche" regenerative gas-lamp. Like the other gas-stove makers, Messrs. John Wright and Co., Limited, show a representative number of their productions, prominent among which is the "Eureka" gas-cooker. At the time of our visit, the stand of Messrs. William Sugg and Co., Limited, was not completed; but it promises to be an instructive illustration of the progress which has been made in producing economy and efficiency in the consumption of gas for lighting and other purposes. A bold show is made by Messrs. Fletcher, Russell, and Co., Limited, with their gas cooking-ranges suitable for providing the meals of a small family or a banquet for a great number of persons. Their exhibits also comprise hot closets and tables, combination gas and coal ranges, gas-fires, and other articles which are found useful in the household. Examples of the Coalbrookdale Company's gas cooking and heating arrangements and castings are also on view. Thorp's adjustable lamp governors are to be seen; and in the illumination of the section, the incandescent gas-burner is largely employed. In closing this part of our notice, it may be added that it is impossible to give here an individual description of all the exhibits, or to point out one particular firm's goods as being superior to others, though nearly all the makers claim (as seems to be the custom throughout the commercial world) pre-eminence in one or more respects. But it may be said that the exhibition shows there is a healthy rivalry between all the well-known firms, especially in the cooking and heating class of gas appliances, to produce goods which, apart from their working results, are striking for good workmanship and finish.

Within the section, space has been found for one of the street-lamps fitted on the system of the Hot Water Supply Syndicate. To this novel arrangement the somewhat repulsive title of the "Pluto" hot water apparatus has been given. The base of the lamp shown is square, and is used for the storage of the water. We are not yet in a position to describe the lamp in detail; but, speaking broadly, water is fed into the tank in the lamp through a ball-cock in the ordinary way. A little tap inside regulates a supply of water which passes up the lamp-column, and is converted into steam; this being led down the lamp for the purpose of heating the water in the tank. It is stated that only about 2 gallons of water are used in ten hours for the heating of 50 gallons. The quantity of gas consumed varies according to the size of the apparatus; but, in the lamp shown (which has a cluster of lights), 26 cubic feet per hour are employed for lighting, and the waste heat is found sufficient for maintaining the supply of hot water. By placing a halfpenny in a slot, a gallon of hot water can be obtained; and that the water is of high temperature may be tested by the lamp in the exhibition. The inventors suggest that between each withdrawal of water, about three minutes should be allowed to elapse. One can quite conceive many situations and occasions in and on which such a means of procuring a supply of hot water would be very convenient; but it would be interesting to learn the results of experiments as to the temperature at which the water can be maintained in an exposed position during extremely cold weather with frequent drawings of water.

In another part of the exhibition, Messrs. C. Wilson and Sons have a stand, at which they show several of their gas fires and cookers. Messrs. Ewart and Son have also on view a number of their geysers, fitted with gas-burners, for heating water; some being in constant operation. One of the latest arrangements is known as the "Auto-Lightning" geyser; and it has been devised for supplying hot water to all parts of a house. The geyser on this plan is fitted at the top part of the dwelling, and at any of the several points at which taps may be fitted, the action of merely turning on and off the hot-water tap raises and lowers the gas under the geyser. When turned off, there is simply an almost invisible blue flame remaining; and, of course, means are provided for extinguishing the flame altogether when hot water is not likely to be required. This is one of the most convenient arrangements we have seen in this particular direction; and it will certainly obviate the liability to accidents in bath-rooms which have happened mainly through the carelessness of users.

The foregoing notes are sufficient to show that there is much in the Gas Section of the Victorian Exhibition of the Crystal Palace to interest and instruct all concerned in the supply and consumption of gas.

POPPLEWELL ON HEAT-ENGINES.*

THIS is a substantial volume, closely printed, plainly bound, containing 375 pages of matter solid enough, to all appearance, to form *pabulum* for the most persevering student through a long winter's reading. According to the author's preface, it is a

* "An Elementary Treatise on Heat and Heat-Engines, specially adapted for Engineers and Students of Engineering." By W. C. Popplewell, M.Sc. Manchester: The Technical Publishing Company, Limited; 1897.

reprint of articles that originally appeared in the "Practical Engineer." Mr. Popplewell describes himself as Senior Assistant Lecturer and Demonstrator in Civil and Mechanical Engineering at the Yorkshire College, Leeds; and he has numerous other qualifications for writing a book about heat and prime movers. There does not, upon the face of it, appear to be much room for another book dealing either with heat or with heat-engines. The two subjects are entirely different, and are usually handled for the purpose of exposition by very different persons. There is a science of Heat, and there is a practice in the design and construction of heat-engines; and it is really remarkable how restricted is the area of contact between the abstract science and the applied practice. Hence it is a little puzzling at first to think out the characteristics of an acceptable book occupying both provinces. When one reflects upon the science of Heat, the memory goes back to Tyndall, and one or two other immortals who made the science what it is; and when one considers heat-engines, the names of a great host of authorities, from Carnot to Clerk, surge into mind. A glance at his introduction, however, serves to show that Mr. Popplewell stands apart from these. He is of the moderns, modern. It is of thermo-dynamics that he wishes to treat, though he does not say so in the title of his book—perhaps for fear of frightening timid engineering students; and thermo-dynamics is a very new branch of science: "Up to the end of the last century, the ideas of scientists as to even the nature of heat were in a very unsatisfactory state"—how sad!—"and most of these, according to more modern ideas, were undoubtedly erroneous. It was not until the year 1798 that the old ideas as to the material theory of heat began to feel that overthrowing force first introduced by Count Rumford, that was destined to entirely destroy it (*sic*), and to raise up in its place the modern vibratory theory of heat, which now appears to be unassailable." Of course, we know all about heat now that we have learnt to regard it as a "vibratory condition of matter." We need not, in these latter days, even be so careful of our English as were our benighted forefathers upon whom the undulatory hypothesis had not dawned.

No matter what theory of the nature of heat had been adopted by "scientists," engineers would have gone on their way without troubling themselves about it if Rumford had not shown the connection between heat and motion, and Joule had not measured it. Mr. Popplewell repeats the familiar story clearly enough; but was it really necessary to do so? His students will think they are led into a very rough country when he gets to the subject of the isothermal and adiabatic expansion of gases, where differentiating and integrating become, as it were, common operations by the way. It is difficult to understand here for what class of students the book is written. Clerk has done the same work before, and done it with greater ease; but he did not pretend to write for elementary students. This mathematical flourishing was not to have been expected after the statement in the preface that the author had kept his mathematical reasoning "of as simple a kind as possible."

When we come to the chapter on gas-engines, Mr. Popplewell suddenly drops into the regulation elementary teacher's style; explaining that "all substances, whether solid, liquid, or gaseous, are either *elementary* or *compound substances*." Then he proceeds to observe that water is a compound of two elementary gases and that it "exists at ordinary temperatures in the form of a liquid." Does a man who can tackle the calculus need this information, which is given, moreover, in a chapter on gas-engines? There is nothing more irritating in a technical writer than this mixing of the simple and the advanced styles of treating the subject-matter. We never know where we are in such circumstances. Mr. Popplewell's chemistry of the combustion of gas is perplexing. He gives the following equation to show how hydrogen and oxygen combine to form steam:—

$$2\,H_2 + O_2 = 2\,H_2O.$$

Wherever he writes the symbol for oxygen he puts the dropped figure after it, thus—O_2. Is this the way they write chemical shorthand in the Yorkshire College? Again, is it quite correct, either grammatically or chemically, to say of a sample of coal gas intended for use in a gas-engine, and found to contain "carbon dioxide, oxygen, and nitrogen," that "none of these burn, and therefore take no active part in the combustion?" We have nothing to say against Mr. Popplewell's detailed observations upon the design and method of working of modern gas-engines, which constitute the best part of his book. If the volume had been cut down to this portion, it would have been to the advantage of the author's reputation. He knows the gas-engine well, and is candid in setting forth both its merits and disadvantages as compared with the steam-engine. He is also able to point out how and to what extent the gas-engine may be improved. The same with oil and steam engines, upon both of which kinds of prime mover Mr. Popplewell is a sound teacher. On the whole, therefore, we are able to say that purchasers of his book will get good value for their money, even if they leave many chapters severely alone. His weaknesses are, in the main, in those respects in which he can be unfavourably compared with greater masters. His strength is unquestionably in his own knowledge of the more practical side of his subject.

GAS LITERATURE AND STATISTICS—MADE IN GERMANY.

The German Technical Press is extremely prolific; and most branches of applied science have been repeatedly handled in ponderous treatises, to the compilation of one of which many an "academically-formed"—in his own parlance—Teutonic scientist will devote a lifetime. Occasionally the treatise proves a world's masterpiece; more often it is a bewildering labyrinth, in which the unessential obscures the essential, and the unimportant obliterates the significant. The several branches of engineering have, however, scarcely met with their appropriate share of either type of the German treatise—perhaps in some measure because academical training merely equips, and does not form the engineer. With the exception of Schilling's "Handbook," which holds in Germany almost the same rank that "King's Treatise on Coal Gas" does here, we can scarcely call to mind one work on gas manufacture published in that country which deserves commendation.

Let us glance for a moment at one of the best known, bearing on its title-page the date 1891, and a statement that it embodies the latest information. We can find no mention in it of the modern washer-scrubbers; nor indeed of any efficient washing apparatus, though such were tolerably common in Germany six years ago. Purification finds very scanty notice; and the removal of sulphur compounds, as pursued for many years in this country, is not mentioned. But we complain less of the absence of information on many important matters, than of the absolute lack of discrimination displayed in the handling of the matter which is dealt with. There are 155 illustrations in the book; and of these about two-thirds refer to coal gas. Yet no fewer than 65 are merely cross-sections of retorts of various shapes and dimensions; and from 30 to 40 only deal with the whole of the remaining apparatus of a gas-works. Such a liberal allowance of figures leads one to expect special information as to the relative values of different patterns of retorts; but we search in vain for even a word as to which is advantageous or commonly used! Surely, nothing can be more confusing to the student, or more exasperating to the gas engineer, than to have such a plethora of illustrations of retorts, and absolutely no guidance as to whether an elliptical, circular, or Ω-shaped pattern is preferable or even popular. The reader, however, may learn a good deal of the methods pursued in the manufacture of retorts; and much good will this information be to him when he is called upon to say which pattern is the best carbonizer! We have taken this illustration from a work on gas manufacture which is by no means the worst of those published in Germany, in order to exhibit clearly the want of a sense of proportion which mars many an otherwise commendable book written in the Fatherland. A writer on any branch of applied science must throughout his work have a paramount sense of the ultimate aim of the art or manufacture of which he is treating, or before he is aware of it he will become discursive on some side-issue which has no direct bearing on the subject in hand, or is of quite minor importance. And if the thread be once dropped, or the reader's attention diverted from the proper channel, then confusion sets in; and the writer has unwittingly failed to do his best by his subject-matter. The writers of recent German text-books on gas manufacture have thus failed; and we are still looking in vain for a work of the kind which comes even moderately near the fulfilment of its aim.

We welcome the first part of a small treatise by Herr Moritz Niemann, the Chief Constructing Engineer of the German Continental Gas Company, but regret to find that its scope is restricted, and that it only pretends to cater for the wants of a class of readers whose interest in gas manufacture is merely incidental. We refer to the surveyors and officials, whose duty it is to set out and maintain the streets of large towns. It is a sign of the thoroughness of the German municipal system, that such officers should be deemed to require special coaching in the supply of water, gas, and electricity, so far as it may affect their own duties. We find a series of text-books for their use; and among them gas, water, and electricity are to be adequately dealt with by a competent authority on each subject. To Herr Niemann has been deputed the task of writing for the special benefit of surveyors and kindred officials on the supply of towns with illuminating gas.* His work is to be completed in three parts; and, as far as we can judge the requirements of the special class for which he is writing, we think he has only to keep the second and third parts up to the standard of excellence which the first displays, in order to give his readers a really valuable summary of gas supply. The first part is chiefly historical and statistical. Statistics evidently form a feature of the work—as, indeed, its special purpose demands of it. We will lay a few of the more striking figures before our readers.

The production of the five Gas Companies which supply the greater part of London and its nearer suburbs, is approximately equal to the total quantity of gas made in Germany. The heaviest day's consumption in London is about the same as the annual consumption of a German town of 100,000 inhabitants. From the figures for several towns in Germany, it appears that the heaviest consumption per month is that of December, and is 14 per cent. of the annual consumption; while the lightest is

* "Die Versorgung der Städte mit Leuchtgas." Von Moritz Niemann. Erstes Heft. Stuttgart: 1897.

that of June, which is under 4 per cent. The consumption for cooking, heating, and motor purposes is tolerably uniform for all the months of the year; varying only from 7 to 10 per cent. of the annual consumption for those purposes. The daily and hourly outputs are important factors in determining the size of mains required in the streets. The heaviest daily output is usually from 1-150th to 1-220th of the annual make; while the lightest is only 1-700th to 1-1800th. The latter figures are about the same as those for the heaviest hourly consumption of the year; or the heaviest hourly output in winter is as great as the lightest daily output in summer. The heaviest hourly output is from 1-5th to 1-10th of the heaviest daily output. Assuming that the average consumption per burner is 5 cubic feet per hour, it appears that from 3-10ths to 6-10ths of the number of burners supplied are in use during the hour of heaviest consumption. The consumption from 4 to 11 o'clock in the evening is 36 per cent. of the daily output in excess of seven times the average hourly consumption per day; and therefore the gasholder capacity must considerably exceed that proportion of the daily output, since the excess consumption during those seven hours must be provided for by storage. The figures for gas consumption for different purposes vary much in different towns; and it is evident that generalizations are of little value. We observe that Cologne enjoys the distinction of using nearly a quarter of its production of gas for public lighting. In 1892, Wetzlar enjoyed the less enviable distinction of a loss of nearly this proportion of its make—thanks to drainage works in the streets.

The consumption of gas for all purposes is about 700 cubic feet per annum per head of the population of Germany. But only about 35 per cent. of the population is to be found in towns of 5000 inhabitants and upwards, and not all such towns have gas-works; so that by far the larger proportion of the population is outside the areas of gas supply. The quantity of petroleum used is nearly 4 gallons per head per annum. It is calculated that the consumption of gas, petroleum, and electricity suffices to allow each inhabitant of Germany light represented by the following numbers of candle-hours: From gas, 2100; petroleum, 3000; electricity, 300. Herr Niemann throughout rightly regards petroleum as the only formidable rival of gas.

We look forward with pleasure to the early appearance of the second and final parts of Herr Niemann's interesting work.

TECHNICAL RECORD.

WESTERN (U.S.A.) GAS ASSOCIATION.

Annual Meeting at Cincinnati.

The Twentieth Annual Meeting of this Association was held on the 19th, 20th, and 21st ult., under the presidency of Mr. W. H. Odiorne, of Springfield, Ill. The first proceeding was a formal welcome from the Hon. John A. Caldwell, Mayor of the city, after which

The President delivered an Inaugural Address. He said that the great depression in business that had prevailed throughout the entire country had necessarily had some effect on the consumption of gas; but gas companies had not suffered to a degree commensurate with other lines of business. Electric light had been introduced to some extent; and, as an offset to this, he recommended cultivating business with the small householders by personal canvassing. There was also a demand for gas-heating appliances. He instanced the increased output at Kansas (Mo.) as an example of what could be done by cheap gas, good management, and liberality in the matter of free stoves and service-pipes. He urged the use of every possible endeavour to secure for residuals a proper tariff protection in Congress, so as to shut out the importation of cheap pitch and other things that injured their business. Referring to adverse legislation, he insisted on the necessity for united action in the way of protecting gas interests, and the prevention of competition; and he was in favour of a Commission similar to that in Massachusetts. As to the claims advanced on behalf of acetylene, time had shown that these could not be obtained in practice; and this once lauded light was now rarely referred to. He spoke in high terms of the useful work done by the Gas Exposition in New York; and thought the promoters were entitled to the sincere thanks of the gas fraternity.

Mr. J. C. Baxter, of Detroit (Mich.), was then called upon to read his paper on "Revivification of Oxide of Iron in Purifiers." At Detroit, he had tried four different methods. The first consisted of a 100-light meter attached to the exhauster-inlet, having the meter-inlet, which consisted of 2-inch pipe, carried up through the roof of the building. Air was admitted in the proportion of 15 cubic feet to each 1000 cubic feet of gas made. By this means, the life of the purifier was prolonged; but the effect on the illuminating power was so marked that the plan had to be abandoned altogether in the winter. Next he tried passing air through the purifiers during the night, at a time when he was using Lowe water-gas apparatus, and that only in the day. Air was drawn into the exhauster-inlet through a 4-inch pipe, and discharged through the vent-hole on the purifier cover into a pipe carried up through the roof. This plan gave fair results; but it was discontinued after a few months, because the purifier cover became heated to a dangerous degree. Then he tried a steam-jet exhausting arrangement attached to the outlet of the purifier, which aspirated air through the inlet. It was worked at 1-inch exhaust, and discharged into the outer air. With this device, dangerous heating of the plates of the boxes and connections was experienced; and it was discarded in consequence. Last summer, he put down four new purifying boxes, each 30 feet by 20 feet by 4½ feet. The boxes previously in use were four in number, each 20 feet by 18 feet by 3 feet, for coal gas; and two, each 20 feet by 20 feet by 6 feet for water gas. During the past winter, the four new boxes had been substituted for the water-gas boxes. While putting in the new boxes, he fitted up a blower with 8-inch connections, so arranged that air could be drawn through either of the ten purifiers as required. In preference to valves, he used seal-boxes between the blower and the purifiers, which were filled with water so long as gas was in the box, and emptied when air was to be drawn through. Thermometers were introduced at various parts of the purifier, so as to keep a check on the temperature. The highest temperature was usually found near the inlet and outlet; but it rarely exceeded 120°. The blower was worked at an average of 7-10ths exhaust; and when an excessive rise of temperature was observed, a slight spray of water was used. This plan had proved a success; and the saving of labour during the six months ended March, 1897, was £12 10s. per month as compared with the previous year. Occasionally the material in the purifier became caked, and the back-pressure increased; and then it was simply broken up, and turned over without being removed. He had purified about 150 million cubic feet of water gas and 60 million cubic feet of coal gas during the winter.

Mr. M'Elroy, being called upon to open the discussion, said he had had considerable experience in the revivification of oxide by mechanical means, and in blowing steam through it, which was often dangerous work. But after he had adopted Sturtevant blowers, with which a vacuum of 1 inch up to 8 inches could be obtained as desired, he had no trouble. The temperature required watching; and the air supply must be adjusted accordingly. The boxes had to be emptied about once in four times, on account of back-pressure. He also recommended water-seals instead of valves, as the heated air passed through a centre-valve would tend to crack it, and make it leak. By this plan, having only eight boxes, each 20 feet by 24 feet, with 22 inches depth of oxide, he had been able to deal with 2½ million cubic feet of gas per day; but he had to revivify every eight hours. Mr. A. S. Miller asked if there was any special advantage in aspirating, as compared with blowing in air, and also as to the speed of the air current through the apparatus. He noticed that the author purified 6000 cubic feet of coal gas and 2900 cubic feet of water gas per bushel per charge; but he was able to purify 32,600 cubic feet of gas per bushel per charge, turning the oxide out each time in the usual way. His labour expenses were very small, only about one-third of the saving claimed by the author; and it also appeared to him that the new boxes, representing a large increase in purifying area, were entitled to some share of the saving obtained. Taken per square foot of purifying surface, he dealt with quite 30 per cent. more gas than the author. Mr. Egner remarked that, in comparing oxide with lime purification, it must be remembered that the oxide did not touch the carbonic acid. He had found, with water gas, that the use of lime saved at least ½ gallon of oil per 1000 cubic feet of gas made. Spent oxide was of value, not only for the sulphur, but also for the cyanogen it contained. Mr. A. E. Forstall said his experience did not agree with that of the author, as he was able to draw in 1½ to 2 per cent. of air without any effect on the illuminating power, and had done so for years. It did not mean one-tenth of a gallon of oil per 1000 cubic feet of gas; and where he only purified 10,000 cubic feet per bushel, he could now deal with 25,000 to 30,000, and had gone as high as 96,000 cubic feet in the summer. His boxes were 24 feet by 29 feet; and last winter he averaged 1¾ million cubic feet of gas per day. The average quantity purified per bushel was just over 30,000 cubic feet. But he ought to add that some of this improvement was due to a plan of heating the gas before the purifier, which he had adopted at the same time as the air system. He described this at the last meeting of the American Gaslight Association. Mr. Thompson remarked that Mr. Miller's boxes were larger proportionately than the author's; and therefore they enabled better results to be obtained. The plan suggested was also of use in clearing gas from the purifier before raising the lid. Heated air should not be allowed to pass through the valves, but should always be discharged outside the purifier house.

Mr. Baxter, in replying, said it was simply more convenient to draw the air downwards through the oxide, than to force it upwards. Oxide might be used instead of lime in works as small as 16 million cubic feet per annum, and with four boxes, each 6 feet by 6 feet by 3 feet; but it would scarcely be worth while introducing the air system.

A paper on "Selling Gas" was read by Mr J. C. Copley, of Aurora (Ill.), who remarked that the same commercial laws which governed the successful selling of any commodity, must also be applied to the sale of gas; but they required modification, according to the size and other conditions of the undertaking. A line of policy that answered well in the case of a small town of 6000 inhabitants, might not do for one of 100,000.

He advocated a good article at a low price, and reasonable liberality in the matter of service-pipes. Without these, energy and intelligence on the part of the management were of little use. There should be a sufficient staff to give proper attention to the sale of gas; and it should be remembered that when a customer was once obtained, his patronage was regular and constant. With regard to the sale of cooking-stoves, a good plan was to put them out on trial. The first year that he was engaged in this department, he placed 272 stoves, of which only 3 were returned. Every opportunity of bringing the stoves before the notice of the fair sex should be turned to account. He was in favour of advertising, and of cultivating a friendly understanding with hardware dealers, plumbers, architects, and builders. The use of gas-engines was greatly prejudiced by their exorbitant cost.

Mr. Highlands commenced the discussion. He said that he kept a record of every house on the line of mains, showing the owner or tenant, whether gas was used, and the possibilities of introducing it. Any ordinary canvasser could get this information; and the list was corrected every year. The agent could be furnished with prices of gas stoves and fittings, and allowed to sell same on commission. The result of the last inspection showed that, on 17 miles of main, there were 175 possible customers; and of these the agent contracted to fit up 34 houses, and sold 40 gas-stoves. Mr. W. M'Donald gathered that the author was a believer in gas; and no one could make a success of selling any article or commodity unless he was himself a believer that it was the best for the purpose for which it was designed. The difference between the policy to be adopted by a small undertaking, as compared with a large one, was not so great as the author seemed to think. The thing was to put the gas at the elbow of the consumer, and leave him to use it or not as he might choose. Mr. Egner thought that Mr. Highlands would have done still better if his agent had thoroughly understood the gas business. He had found it a good plan to send a man to a grocery store with some stoves for a few days. The storekeepers had no objection; and everybody who came in saw the stoves. Mr. Jones thought it was a mistake to instance electricity as safer than gas. Mr. Doane said he sent out a canvasser to make a house-to-house inspection of his district, and authorized him to sell stoves on the understanding that they would be fixed free, and £1 worth of gas thrown in gratis. The result was very satisfactory. Mr. Doherty had turned his attention to the question of a small stove that would heat the kitchen in winter, and so secure the use of the cooking-stove all the year round, instead of only in the summer. Another drawback was the question of the heating of water for a constant supply. Instantaneous heaters were unsatisfactory, as calling for a very large supply of gas for a short time; and a constant supply system was needed.

Mr. J. R. Lynn, of Detroit, read a paper describing an "Oil-Tar Separator." He said that no approach to complete separation of carburetted water gas tar from the liquor could be obtained, except under special conditions, owing to the very slight difference in specific gravity. The mixture must be kept at a temperature of not under 70° C. for a sufficient time to allow the whole to come under the influence of the heat. The dimensions of the separator, and the extent of heating surface, must be proportioned to the quantity of liquid to be dealt with. His average consumption during the winter was 4500 gallons daily of Lima proof gas-oil of ·830 sp. gr., which yielded 8 to 15 per cent. by bulk, or 9 to 17 per cent. by weight, of tar. Naphtha would give somewhat less, and crude oil more; and he had observed that the yield of tar was a good index of the condition of the plant. Having found traces of undecomposed oil in the tar, he introduced vaporizers of considerable length, which proved a success, as the yield of tar was thus reduced to 8 per cent., while the make of gas per gallon increased. But for his separator, this matter might have been undetected for a long while. He also worked the Pintsch process on a small scale, which gave 15 per cent. by bulk, or nearly 20 per cent. by weight, of tar. This, as well as the pumpings from the street syphons, was thrown in with the rest, and passed through the separator. The dehydrated tar from the water gas gave on distillation 24 parts of light oil (containing 15 per cent. of pure benzene), 14 of intermediate oil, 10 of heavy oil, 14 of naphthalene, and 38 of pitch. The Pintsch tar contained 60 per cent. of intermediate oil of a boiling-point about the same as that of the original, 10 of light oil, 10 of heavy oil, and 15 of pitch. The separator was enclosed in a pit lined with brick and cement, and having a wooden cover. It comprised two wrought-iron tanks, one 10 ft. by 4 ft. by 1 ft. 4 in. deep, and the other 20 ft. by 6 ft. 8 in. by 6 ft. 4 in. deep. The small tank was placed crosswise at one end, and slightly lower than the top of the second; and it was divided longitudinally into seven sections by baffle-plates, open at each alternate end, and having 1¼-inch pipes extending from end to end, through which waste steam was passed. The liquid, being admitted to this, is raised to 160° Fahr. by the time it reaches the outlet leading to the larger tank, which is divided into eight sections by cross partitions. The first, third, and fifth extend from the top of the tank downwards to about 18 inches above the bottom; the second, fourth, and sixth extend from 12 inches above the bottom to within 18 inches of the top; and the seventh is similar, but continued to the bottom. A steam-coil, having an 80 feet length of 1¼-inch pipe, and fed with live steam, is fixed in the third division; and the liquid passes under and over the partitions. Draw-off pipes with separate cocks are fitted in each division; heavy tars being taken from the bottom of the first and eighth, and light tars from near the surface in the first, second, fourth, fifth, and eighth, in which there is also an outlet for the water to pass off, at about the middle of the depth. As long as the level of the light tar is kept from sinking, or that of the heavy tar is prevented from rising to this overflow, only water will pass off. The total cost of the whole arrangement, fitted complete, was £225. He had not so nearly approached perfection as others had claimed to do; for the tar, after treatment, retained over 5 per cent. of water. He was therefore not able to sell it at present, but hoped to do so eventually. He used it as fuel, with a steam-jet burner; and he found that 1 gallon of the tar would raise as much steam as 9½ lbs. of Youghiogheny slack coal. The evaporative power was 82 lbs. of water per gallon; and the value for boiler purposes was about ⅜d. He had been able to gradually improve the results as he gained experience; and he hoped to continue to do so.

Mr. A. S. Miller remarked that the calorific value of the tar, according to the experiments, was very low; and he suggested that more water must be contained in it than was supposed. Weight for weight, it was less than that of coal; whereas the usual experience with liquid fuel was that it was much higher. According to his experience, the temperature was right; but the partitions in the large tank were too deep. There should be at least 30 inches clearance under them, so that the flow of liquid should not stir up the tar. If Mr. Lynn made this alteration he would probably do as well as others. The second heater was unnecessary. He quoted some half-dozen places where the water was separated to within 1 per cent. Mr. Wallridge said that if large quantities of water were used for washing, the difficulties of separation were increased; and he suggested that the author might consider this point with advantage. He had been able to do with as little as 6 gallons per 1000 cubic feet of gas; and the lower it was brought, the better. Mr. Egner had used a separator similar to that described, with satisfactory results, so far as freeing the water from oil or tar was concerned. Mr. Finnegan had used an old scrubber as a separator. It held about 7000 gallons; and when the tar from the bottom of a large storage tank was treated by heating to a temperature of 190° Fahr. for four or five days by means of an arrangement of 2-inch steam-pipes, he obtained about 20 per cent. of oil and 2 per cent. of water.

Mr. J. S. Lynn, in reply, said it was true that he doubted whether tar was ever brought in practice to contain under 1 per cent. of water, except by heating to over 212°. The calorific test he had named was simply a rough practical one; the boiler, &c., not being arranged for getting the best results.

Mr. F. Egner, of Norfolk (Va.), then read the paper, entitled, "A Study of Inclined Retorts in Europe," which appeared in the "JOURNAL" last week (p. 1355). It led to a conversational discussion, in the course of which Mr. Moss gave a detailed account of his experiences in introducing the system at Burnley (Lancs.), and spoke very highly of it; saying he could get from 35,000 to 40,000 cubic feet of gas per man per 24 hours.

Mr. G. T. Thompson, Editor of the "Wrinkle Department," was next called upon to present his report, which included a description of a coke elevator and hopper for use with generator furnaces, an oil-gauge indicator, a sight-box for oil over-flow pipe, and several other suggestions for water-gas plant. One interesting proposal was the use of a distinctive colour for pipes about a gas-works—gas-pipes might be blue, steam-pipes red, water-pipes white, oil pipes green, &c. A new steam-injector for gas-holder tanks, for which good results were claimed, consisted of a truncated cone of galvanized iron 30 inches long and 12 inches wide at the thick end, tapered up to 4 inches at the other, with the steam-pipe carried in at the wide end to the centre, and discharging toward the narrow end. Several other items were also included. The whole was subsequently discussed in a conversational manner.

(*To be continued.*)

THE IMPORTANCE OF BENZOL AS AN ILLUMINANT.

By Dr. KRAMER.

[Abstract of a Communication to the Verein fur Gewerbefleiss.]

Benzol consists of 12 parts by weight of carbon and 1 part of hydrogen; its composition being expressed by the formula C_6H_6, which corresponds with three times that of acetylene. Benzol is, in fact, nothing else than a polymer of acetylene; and there is no doubt that it owes its existence to this substance. In the products yielded by the dry distillation of wood and coal, the superheating of carburetted hydrogen, as in the manufacture of oil gas, and in many others obtained by similar processes, acetylene, which is always present, is for the most part concentrated into benzol or products allied with it.

Good coal tar yields about 1½ per cent. of benzol and toluol together. But this yield cannot be relied upon; so that one must be content with 1 per cent., or even less, of benzol mixture. Considerable quantities of coal tar would therefore be required to meet the demand for benzol; and consequently endeavours were made at an early date to find a fresh source of the latter. It was then found that, on distilling coal, while only about 8 per cent. of benzol remained in the tar, about 92 per cent. went into

the resulting gas. Inasmuch, however, as benzol is the main supporter of illumination, the process had to be abandoned. A further source of benzol was afforded by the superheating of hydrocarbons rich in hydrogen, especially lignite oils; but petroleum residue has not afforded, as was at one time expected, an economical source of benzol. This recovery is practically confined to the hydrocarbon mixture obtained as a bye-product in the compression of heavy oil gas for lighting railway carriages, about two-thirds of which consists of benzol; but the author does not think that any works for thus producing benzol still remain in operation, on account of the great fluctuation which occurs in the price of this substance—viz., from 400 to 40 marks per 100 kilos (2 cwt.).

On account of these great variations in price, the industrial production of benzol can never be carried on alone, but must always be dependent on the production of other substances. A complete revolution in the conditions of the benzol manufacture must be attributed to the process of coal distillation—*i.e.*, the coking of coal for the recovery of the bye-products—which is undoubtedly destined to entirely supersede the old method of coke making, which allows the gaseous products of coal to go to waste or only to be used for firing purposes. At first, besides sulphate of ammonia, only large quantities of tar were intercepted, by working up which the production of benzol was somewhat increased; but afterwards the extraction of benzol from illuminating gas was thought of, and its production from coke-oven gases was begun.

The movement for the simultaneous recovery of benzol from coke-oven gases commenced about the end of the eighties—at first with poor results, because the quantity of benzol contained in these gases scarcely amounted to half that found in lighting gas. But the conditions in this case were more favourable, as the illuminating power of coke-oven gases was not required. Moreover, part of their heating power could be dispensed with, as more gas was always produced than was needed for firing the ovens; so that at last the difficulties were overcome.

For purifying benzol, certain coal-tar oils of high boiling-points are employed; and the process is carried out in large towers and columns of considerable cross section, furnished with spray arrangements. The current of gas meets the oil in a finely-divided state, spread out over large surfaces, and thus takes up the benzol, which is subsequently distilled off from the oil, and purified in the usual manner, while the oil, after cooling, may be used over again for the same purpose. The slackening of the current of gas, together with the best possible subdivision and application of the oil, and an effectual cooling of both gas and oil, as well as of the washing apparatus, constitutes the whole secret of this new industry, which seems destined to provide the aniline colour manufactories with a nearly inexhaustible source of benzol.

The high cost of the apparatus was at first a great obstacle to an extended application of the process; and to this was afterwards added the difficulty of storing the benzol, the price of which, so soon as the large quantities of the substance made from coke were put upon the market, went down to 25 marks per 100 kilos. (12s. 6d. per cwt.). The quantity of benzol thus recovered up to the beginning of last year amounted to between 4500 and 5000 tons per annum. Inasmuch as, contrary to all expectation, the demand for benzol continued to increase last year, with a corresponding rise in price, so that at the beginning of the present year as much as 120 marks per 100 kilos. (£3 per cwt.) were sometimes paid, the interest of coke-oven owners in putting up benzol plants again increased, so that one now hears of several new installations, the yield of which, when they all come into operation, will go far to meet the demand. The question now arises: What is to be done with the benzol which is not used in aniline factories? As the price had fallen to 30 marks per 100 kilos. (15s. per cwt.), and even less, the gas-works received the supposed surplus, and employed it for carburetting the gas, after Herr Bunte and Herr Schilling had proved that no agent suitable for the purpose was so cheap and efficient as benzol. The former showed that the illuminating power of a gas of moderate quality could be increased one candle power by 4 grammes of benzol per cubic metre (3·8 oz. per 1000 cubic feet); the figures being even more favourable when the working was on a large scale. As it was also evident that a number of other advantages were connected with the employment of benzol as a means of carburetting, especially an easier desulphurization of the gas, prevention of stoppages of pipes by naphthalene, and production of more compact coke, the application of benzol for this purpose became greatly extended.

This circumstance may, to a certain extent, account for last year's scarcity of benzol, as already mentioned. In any case, it is sincerely to be hoped, in the interest of benzol producers, that gas-works managers will not again be deterred from employing it in consequence of high price. In any event, however, the consumption is limited. For instance, as regards Hamburg, which is the second large centre of consumption in Germany, and which burns some 40 million cubic metres (about 1412 million cubic feet) of gas per annum, the benzol consumption is estimated at 300 tons per annum at the outside. It follows from this that the managers of those gas-works which have at their disposal good and cheap gas need not at once adopt benzol enrichment, especially since, with the extension of incandescent lighting, the production of highly illuminating gas has become of less importance than it was formerly.

The question of the destination of benzol so soon as all the plants now in course of erection, or arranged for, come into operation, is therefore very apposite, especially in connection with the future, when all coke-ovens will be equipped for recovering the bye-products, including benzol, not merely in Germany, but probably also in the other coke-producing countries, especially Great Britain, Belgium, and the United States, not one of which, excepting Belgium, participates to any appreciable extent in this movement at the present time. In Germany alone, at least 14,000,000 tons of coal are every year made into coke, including 40 per cent. in closed retorts, which admit of recovering without difficulty the benzol from the coke-oven gases.

Let us now consider with Hüssener that from a ton of coal, on an average, 5½ kilos. (12 lbs.) of 90 per cent. benzol may be obtained; though some coals yield as much of this substance as 8 kilos. (17 lbs.) per ton. About 30,000 tons of benzol may therefore be obtained in Germany alone; and, when all the coke-ovens are arranged for its recovery, the production will attain fully 80,000 tons. That such quantities can ever be absorbed by the gas-works and colour factories cannot for a moment be supposed, as the consumption by these two industries last year scarcely exceeded 20,000 tons, of which not quite 10 per cent. was used for carburetting gas. As regards the surplus of benzol, it is evident its direct application to lighting purposes at once suggests itself; but inasmuch as benzol *per se* is not adapted for this purpose, on account of its high content of carbon, suitable lamps must first be made to burn it.

As early as the fifties, a combination of alcohol and substances rich in carbon, such as turpentine, &c., was employed for lighting; and lamps were filled with this mixture, called camphine, for which benzol is specially suitable, as it is soluble in spirit in almost all proportions. The first circumstance that led to experiments in this direction, which were begun by the author's colleague, Dr. Spilker, and afterwards completed in the laboratory of Julius Pintsch, with the co-operation of Herr Albrecht, was the appearance of the incandescent spirit-lamp. The author and his collaborator considered, that in connection with the illuminating power, the calorific effect, and still more the temperature of combustion, of alcohol must be taken into consideration. Inasmuch as both of these are comparatively low, a substance like benzol and its congeners, rich in carbon and free from nitrogen, must be added in order to obtain the best results.

Careful experiments were made with dimethylbenzol (xylol), which, nothwithstanding its high boiling-point, and considering that it might be obtained more cheaply than benzol, was then preferred to the latter. Ultimately, however, the experiments were also extended to the so-called heavy benzol of tar oil, as well as to naphthalene and the 90 per cent. benzol of commerce; the latter being a mixture of about 16 parts of toluol and 80 parts of benzol—a 95° debased spirit being employed. For determining the actual calorific power, a Junker's calorimeter was used; the tests lasting an hour, and gave, for an average of several tests, the following results:—

	Calories.
With 95° spirit	6100
With a mixture of—15 per cent. xylol and 85 per cent. spirit	6700
" 25 " " 75 " "	7200
" 33⅓ " " 66⅔ " "	8226

It was evident from the tests with the incandescent lamp that the proportion of 15 per cent. xylol to 85 per cent. spirit must not be exceeded, but that, without diminishing the illuminating power, xylol might be replaced by naphthalene, heavy benzol, and 90 per cent. benzol, either partially or entirely. Naphthalene proved to be the least suitable substitute, inasmuch as it was not sufficiently soluble in cold spirit, and therefore became crystallized on the wick when the lamp was extinguished, which caused great inconvenience when it was again lighted. Without taking into consideration the illuminating power, the same lamp with the same incandescent substances consumed per hour 100 parts of spirit alone, 78 parts of spirit when mixed with 10 per cent. of xylol, and 69 parts when mixed with 15 per cent. of that substance; while, when taking the illuminating power into account, these figures become 100, 81·4, and 73·2 respectively. These figures show that there is a saving of 26·8 per cent. when the 15 per cent. addition is employed, supposing the xylol mixture to be no dearer than the debased spirit alone, inasmuch as the xylol need not be perfectly pure—*i.e.*, of constant boiling-point—and may also be replaced by its higher congener, cumol.

So long as the incandescent spirit lamp cannot be superseded by the incandescent petroleum lamp recently brought out, it is rational to use the mixture above described, instead of the pure spirit. The matter is, however, far different as regards the substitute for petroleum in common lamps, which may also consist of such a mixture, but which cannot yet compete with the universally low-priced petroleum. Petroleum is at present still too cheap, and benzol too dear, for any considerable consumption of the latter in conjunction with spirit to be thought of for lighting purposes, except as regards its utilization in incandescent spirit-lamps, for which an addition of from 10 to 15 per cent. may be strongly recommended.

In the discussion which followed the reading of the paper, Dr. Frank, of Charlottenburg, expressed the opinion that far

larger quantities of benzol would be required for the carburizing of lighting gas. Contrary to Dr. Krämer's assumption, that two grammes (30·86 grains) of benzol would suffice per cubic metre (35·3 cubic feet) of gas and per Hefner candle, he considered that just double this quantity would be required in the case of 13 to 14 candle gas. He added that still less favourable figures were obtained from the experiments of Herr Schimming and Herr Jaeger in connection with the enrichment of gases having but slight illuminating power mixed with water gas, inasmuch as with these thin gases from 7 to 9 grammes (or nearly ¼ oz.) of benzol were needed per cubic metre per candle. Dr. Frank further asserted that, from an economical point of view, it will hardly pay to employ a more valuable product for a purpose in which it will have to compete with a substance that must remain cheap, and will never attain the average cost of benzol even if its price be raised. Moreover, he did not consider that benzol would ever be largely used as a lighting material, but that illumination in the future would be effected by means of acetylene. In replying upon the discussion, Dr. Krämer observed, with respect to carburation, that, according to Dr. Rau, 2 grammes of benzol were sufficient for 1 Hefner candle. Similar figures were arrived at by Herr Riess and Herr Schilling in Munich; and he believed also by Professor Lewes, of London. As opposed to the opinion of Dr. Frank that benzol could be economically employed for carburetting gas when its price was only 28 marks per 100 kilos. (14s. per cwt.), he knew as a positive fact that 50 marks per 100 kilos. (25s. per cwt.) had been paid for benzol at several gas-works during many years. This was perfectly reasonable, because with the carburation there was connected a number of other advantages, such as greater facility for purifying the gas and freeing it from sulphur, as well as the production of a better coke. He had never had any idea of carburetting water gas by means of benzol, because this substance could not be dissolved in gas without methane. It was true that it could be evaporated with water gas at a certain temperature; but the benzol again became separated as soon as the gas was cooled down, and had any considerable distance to travel. He stated that careful tests had been made by one of his friends, who was convinced that water gas could only take up benzol permanently when mixed with illuminating gas. With regard to acetylene, he did not share Dr. Frank's opinion, inasmuch as, to begin with, this material was very costly—much dearer, in fact, than benzol. With calcium carbide at 50 marks per 100 kilos. (25s. per cwt.)—a price that could scarcely be much reduced—100 kilos. of acetylene would cost fully 100 marks (£5). He considered that it was not at all certain that benzol, which is a polymer of acetylene, and is burnt in a similar manner, would give exactly the same illuminating power as acetylene itself, especially when it was borne in mind that in carburizing lighting gas, benzol had proved the more suitable substance. Therefore, one was not quite sure that benzol might not be used as an illuminant by itself.

DR. PERCY FRANKLAND ON THE LONDON WATER SUPPLY.

At the Meeting of the Society of Arts on the 19th ult., Dr. PERCY F. FRANKLAND, F.R.S., Professor of Chemistry at Mason College, Birmingham, read a paper on "The London Water Supply," the principal portions of which are given below.

The author began by referring to the lecture he delivered before the Society some thirteen years ago on "The Upper Thames as a Source of Water Supply;" and he remarked that, though the water supply of the Metropolis is virtually the same now as it was then, there is much to be said about it which was altogether unknown in 1883. While the chemistry of the subject has remained unchanged, another science,—viz., bacteriology—then in its infancy, has arrived at maturity, and has come forward to supplement our knowledge of the factors which are of importance in securing the wholesomeness of drinking water. It is to the discoveries made in this science that is due the great change wrought in the opinion of hygienic authorities concerning the subject of water supply in general and that of the Metropolis in particular.

It is almost a matter of common knowledge that the solicitude for securing a pure water supply is occasioned by the now undisputed fact that at any rate typhoid fever and Asiatic cholera may be communicated by water which has received the excreta of persons suffering from these diseases; and it has been shown by the classical researches of Koch, Eberth, Gaffky, and others, that each of these diseases is due to a specific micro-organism. All efforts to combat these diseases must therefore be aimed at destroying not only the specific bacteria themselves, but removing the conditions which are favourable to their vitality and multiplication. The questions then arise: What becomes of these two bacterial forms which carry within them such potentiality for mischief when they gain access to water? Is their duration of life in water long or short? Do they multiply or degenerate? Are they removed in the natural and artificial processes of purification to which water is subjected?

If typhoid fever and Asiatic cholera are produced by specific bacteria, one would naturally suppose that bacteriology would render material help in the adjudication of the fitness or otherwise of any particular water for dietetic use, by furnishing information as to whether or not it contained these specific forms. The author showed how illusory such a suggestion is, even upon the most superficial reflection; and he emphasized the fact that it is not by discovering the presence or absence of specific disease-producing micro-organisms in different waters that bacteriology has placed sanitary science under any debt of gratitude in the past, and that it is equally unlikely it should do so in the future. Inasmuch as nearly all surface waters are liable to more or less contamination with sewage, in which the specific bacilli of typhoid fever, at least, may at any time be present, we are naturally led to ask: What will be the fate of these bacilli in those purification processes, natural or artificial, to which it is now usually regarded as imperative that such surface waters should have been submitted before they are used for drinking purposes by man? Thirteen years ago, there was practically no evidence from which any conclusion could be drawn as to the value of the processes referred to in the removal of dangerous bacteria present in water. But in 1885 the author turned the resources of modern bacteriological methods on to the investigation of these processes as applied in connection with the London Water Supply; and during three years he made regular monthly examinations, for the Local Government Board, of all the waters supplied to the Metropolis. They at once furnished the most decisive and unmistakable information as to the value of those processes; showing, as they did, that on an average about 98 per cent. of the micro-organisms contained in the unfiltered river waters were removed in the treatment to which the waters were subjected before being distributed to the consumer. One would have supposed that the announcement of the fact that purification constituted a material protective measure against the water carriage of epidemic disease would have afforded considerable gratification to the consumers; but, incredible as it may appear, it produced precisely the opposite effect—giving rise to consternation and alarm at the thought that London waters contained micro-organisms at all. It was, in fact, some years before the significance of the author's results was generally understood and appreciated; but by 1892 they had been accepted by every scientific witness who appeared before the Royal Commission on the London Water Supply which was then sitting.

The purification of the river water supplied to the Metropolis is effected, as our readers are aware, by two distinct processes—storage and filtration; and Dr. Percy Frankland proceeded to show the special importance of each operation. The object with which large storage reservoirs have been constructed at great cost is to give the more or less turbid surface water such prolonged repose as will lead to the subsidence, as far as possible, of the suspended particles it contains, and thus diminish the amount of work in clarification subsequently devolving upon the filter-beds. The bacteriological effect of this subsidence of solid particles engaged his attention in 1884; and in the following year he showed, in a paper published in the "Proceedings" of the Royal Society, what a remarkable effect this has in removing the bacteria present in the water. Subsequently, in 1892, he had the opportunity of testing the results of his laboratory experiments on a large scale at the storage reservoirs of the several London Water-Works, in connection with an investigation he was making for the purposes of the Royal Commission. He gave the results of these investigations; and they showed that the process of storage alone is capable of removing a very large proportion of the bacteria originally present in river waters. Further, an inquiry into the bacteriological effect of softening water by Clark's process demonstrated its capability of removing 98 to 99 per cent. of the micro-organisms contained in untreated water. After the water has undergone the process of subsidence, the number of bacteria which the filter-beds have generally to deal with is very small. But even when the unfiltered water contains a large quantity, they can be brought down to quite insignificant numbers by the process of sand filtration. For example, raw water taken from a filter-bed at the Chelsea Company's works at Thames Ditton on Aug. 20, 1892, contained 2548 bacteria per cubic centimetre; whereas after filtration it had only 20. The end of the following month, unfiltered water, taken from the suction-tank at the adjacent works of the Lambeth Company, contained about 7000 bacteria in the above-named quantity of water; but after treatment the numbers ranged from 4 to 79, and these were for the most part due to past-filtration sources. These results clearly show, as the author pointed out, that the processes of storage and filtration, as practised on London water, constitute two very powerful bacterial barriers which are interposed between the rivers on the one hand and the mains on the other. Owing to these barriers, it must obviously be very improbable that any particular micro-organism, whether harmful or harmless, present in the original river water, will reach the consumer.

The figures given by Dr. Percy Frankland representing the numbers of bacteria present in the raw river waters, in the same waters after subsidence, and again after filtration, referred to those harmless bacteria which are the [normal inhabitants of surface water, and are wholly unconnected with disease. But he went on to show that the pathogenic micro-organisms are not naturally denizens of potable water at all—their natural *habitat* being the interior of the bodies of those animals on which they are parasitic; and he thought it was not unreasonable to inquire whether bacteria when placed in surroundings so entirely different from those to which they were accustomed might not suffer seriously from so radical a change in their

environment. Of course, an answer to this question could not be expected from an examination of natural waters known to be contaminated, for such harmful or pathogenic bacteria must of necessity be present in such small number in potable water that the chance of detecting them was almost infinitesimal; the search for them, in fact, being as futile, said the author, as the proverbial "looking for a needle in a haystack." The question might, however, be approached in an experimental way by infecting waters of different kinds with such large numbers of particular pathogenic bacteria that their presence could be detected by cultivation, and their multiplication or degeneration ascertained. His first experiments in this direction were undertaken in 1886; and they were intended to ascertain what would be the fate of the cholera bacilli if they should gain access to waters of different kinds. The waters selected for the purpose were: (1) Deep well water, as supplied to a part of London by the Kent Company; (2) filtered Thames water, as supplied to the greater part of London; and (3) ordinary London sewage. In order to simplify the inquiry, the waters were in each case deprived of all the organisms they naturally contained —*i.e.*, they were sterilized by steaming them for a sufficient length of time; and it was only after this that the cholera bacilli were introduced. The results were peculiarly instructive, and showed how different is the endurance of this organism in waters of varying composition. In the sewage it was found to be still alive after eleven months; while in the Thames and deep-well waters it did not maintain a livelihood for more than a fortnight or three weeks. In similar experiments, conducted by other investigators on the typhoid bacillus, it was found that in sterilized drinking water the bacillus was able to maintain itself in a living condition in some cases up to 80 days. The comparatively short duration of the vitality of cholera and typhoid bacilli when introduced into water is, no doubt, due to the fact that neither of these organisms occurs in those hardy and difficultly destructible forms known as spores. In order to investigate the behaviour, in water, of a pathogenic organism which forms spores, the author selected the bacillus of anthrax, which and its spores he introduced into filtered Thames water and London sewage, both of them previously sterilized so as to simplify the investigation. The number present in the first hour was: Sewage, 753; filtered Thames water, 340. After 61 days, the numbers were: Sewage, 5543; filtered Thames water, 100. The spores of this bacillus would thus appear to possess almost unlimited vitality in potable water; while in sewage the bacillus underwent extensive multiplication.

The foregoing results were obtained with sterilized waters; but Dr. Percy Frankland conducted a number of experiments to ascertain what takes place when such pathogenic bacilli as those mentioned above are discharged into natural waters. They showed that anthrax spores remained alive in practically undiminished numbers in sterilized Thames water; while in the same water unsterilized anthrax was barely discoverable by cultivation after 104 days. As regards virulence, the sterilized water proved fatal to mice even after seven months; while the unsterilized, on inoculation into mice, failed to kill. On the other hand, it was found possible to revive the virulence of the anthrax by adding nutritive broth to the unsterilized water; for after doing so the water became again fatal to mice on inoculation. Similar waters containing anthrax, which, however, had been exposed to 151 hours' sunshine during these seven months, were found not only to have lost their virulence, but the virulence could not be restored by the addition of broth. These experiments furnished a good example of the bactericidal action of sunshine on micro-organisms suspended in water. The author also made a number of experiments on the vitality of the typhoid bacillus in both sterile and unsterile waters; and he directed special attention to one series, in which he simultaneously introduced the same number of typhoid bacilli into Thames water, Loch Katrine water, and deep-well water, so as to be able to institute a comparison between these three different types of water as regards their power of supporting the bacillus in a living state. The principal points he emphasized in connection with these results were: (1) That in none of these three types of potable water did the typhoid bacillus exhibit multiplication; but, on the contrary, in each case there was more or less rapid numerical decline of the bacilli. (2) That in the case of the surface waters—Thames and Loch Katrine—the longevity of the typhoid bacilli was much greater in the sterilized than in the natural samples. In the case of the deep-well water, on the other hand, the duration of life was practically the same in the sterilized as in the unsterilized samples. (3) In the sterilized waters, the longevity of the typhoid bacillus was greatest in the Loch Katrine, and least in the case of the deep-well water. In the unsterilized waters, however, the duration of life was most protracted in the case of the deep-well water, and most curtailed in that of the Thames water. These results distinctly indicate the greater danger attending the access of typhoid bacilli to subterranean than to surface waters.

Summarizing the various points he had brought forward, the author remarked that the bacteriological processes going on between the moment of contamination of a river water, like that of the Thames or the Lea, and the distribution of that water to the consumer, were both numerous and complex. Briefly put, they were: (1) Continuous destruction of pathogenic forms through the marked bacteriological influence of surface water. (2) The prejudicial influence of light on bacterial life, which makes itself felt until the water passes through the sand filter and is withdrawn from this influence. (3) Subsidence of bacterial life during the sojourn of the water in the storage reservoirs. (4) Removal of bacteria in the process of sand filtration. He went on to say that, from the mass of experimental evidence he had brought forward with regard to the fate of pathogenic micro-organisms gaining access to water, he thought it must be conceded that, unless they were present in very large numbers indeed, they would have but little chance of leaping the barriers imposed by storage and filtration, provided these processes were properly carried out. In the absence of such methods of purification, however, a river highly contaminated with sewage might distribute cholera and typhoid among its consumers, as had been amply attested by the experience gained in the case of the Seine at Paris and the Elbe at Hamburg. The author gave particulars of these cases; the facts in regard to which, especially that of the Elbe, being well known to most of our readers.

Coming to the question of the quantity of typhoid virus which can be present in the waters of the Thames and Lea as they reach the intakes of the works, Dr. Frankland referred to the interesting calculations on this matter made by the late Royal Commission. Taking the number of cases in the Thames Valley above Molesey as 1001 and those in the Lea Valley above Chingford as 195, there would be one case for a mass of Thames water 5 miles long, 100 yards wide, and 6 feet deep, and one for a body of Lea water of the above-named width and depth, and 3 miles long. The Commission therefore came to the conclusion, from the evidence put before them, "that the amount of active specific typhoid poison that can get into the Thames or Lea, whether under ordinary conditions or in time of flood, is infinitesimally small when put into comparison with the enormous volume of water with which it will be diluted." Besides, it is obvious that, in the passage through a river and during prolonged storage in a reservoir, such typhoid bacilli as might be originally present would become thoroughly separated from their toxic chemical products, which so greatly assist them in their attack. But is any evidence afforded, by the statistics relating to the mortality from typhoid fever in London, of the communication of this disease by the present water supply? Dr. Percy Frankland quoted figures compiled by Dr. Shirley Murphy, the Medical Officer to the London County Council, to answer this question in the negative. He showed that the average annual death-rate from enteric fever in fourteen towns in which the water supply is stated to be absolutely above suspicion—*i.e.*, "not excrementally polluted" —ranged, in the ten years 1881-90, from 1·5 to 4·9 per 10,000 inhabitants; whereas in London, with its population of about 4¼ millions, the rate was 1·9.

While claiming that the facts he had so far brought before his audience had clearly shown that the treatment which the river waters undergo before they are supplied to London is capable of purifying them in a highly remarkable manner, and that the efficiency of this purification is proved by direct experiment to be far greater than could have possibly been anticipated on *à priori* grounds, the author acknowledged that it would be dealing with the subject most unscientifically to let the matter rest there without inquiry as to whether the purification processes really did go on with the same degree of efficiency from one year's end to the other. In the monthly examinations of the London waters which he made during the years 1886, 1887, and 1888, there were two conspicuous occasions on which exceptionally large numbers of bacteria were found in some of the filtered waters; and on both occasions this disturbance coincided with a very low temperature of the river water. Under such conditions, it was highly probable that the water on individual filter-beds was actually frozen. The presence of ice on the filters was, he said, well known to be one of the most serious troubles incidental to sand filtration—the removal of the ice involving sometimes the employment of large numbers of men; and it was easy to understand how in this operation the surface sand, which is the most important part of the whole bed, might become disturbed, with the result that the efficiency would be impaired. Again, if the frost actually gained access to the sand, it was obvious that serious disturbance must take place; for, through some of the filter-beds becoming choked with ice, it would become necessary to filter at a greater rate through the beds which remained open, with the result that an inferior filtrate would be obtained. The author remarked that, in the critical age in which we live, it is perfectly futile to gloss over defects of this kind, either by attempting to conceal the facts, or by endeavouring to explain them away by means of specious arguments and authoritative statements. It is, in fact, a matter in which the inhabitants of the Metropolis should, he said, absolutely set their face against anything in the shape of "special pleading," which was not fair to those conscientious men, the Engineers of the Water Companies, who, fully realizing their great responsibilities, were straining every nerve to give London the very best supply of water which lay in their power. He felt sure that it was only necessary to call their attention to the imperative necessity of facing and dealing with this periodical difficulty which presented itself in connection with the existing purification processes, in order that it should be speedily overcome. For that it could be overcome had been demonstrated by the experience gained at the Altona and the new Hamburg water-works, where a very inferior raw material,

and much more unfavourable climatic conditions than those in this country, had to be reckoned with.

If the educated public of the present day are averse to *ex parte* statements on behalf of the present water supply, they must surely, said Dr. Percy Frankland, also repudiate an unwarrantable condemnation of it. It had, however, been attacked by the London County Council, in certain reports presented to them by their Chemist (Mr. W. J. Dibdin), and by Drs. Dupré, Klein, and Stevenson. The reports of Drs. Dupré and Stevenson did not call for reference, for these gentlemen found nothing very remarkable in the samples of water which they examined, and they only published a few figures which admitted of comparison either with those of their colleagues or with those obtained by other observers. He must, however, enter a public protest against the bacteriological standards by which they undertook to adjudicate upon potable water. Dr. Dupré, in his report, said: "Taking the number of these organisms permissible in a drinking water at 100 per cubic centimetre, as fixed by Professor Koch, not less than 35 [samples] out of the 64 [examined] exceeded this limit." Dr. Stevenson said: "I adopt 100 organisms per cubic centimetre as the maximum number permissible in a good drinking water, taken from a river and efficiently filtered." "Both these gentlemen," remarked Dr. Percy Frankland, "thus put upon Dr. Koch the responsibility of judging these samples by a standard made in Germany, and which, like some other commodities coming from that country, it would be desirable to exclude from our shores." He went on to say that the worthlessness of a standard of purity had long since been demonstrated in the case of the chemical examination of water; and all who had had a sufficiently prolonged and varied experience in its bacteriological examination had come to recognize that bacteriological standards were equally fallacious and unscientific. It was particularly noteworthy that, in the reports of Drs. Dupré and Stevenson, even the Kent Company's deep-well water, the purity of which had hitherto failed to find an assailant, did not escape condemnation by this "inspired" standard; and he should very much like to know whether these gentlemen, with their long experience of the sanitary aspect of water supply—an experience which he had no hesitation in saying was far more extended than that of Dr. Koch—really thought seriously of that Company's water, on the occasions when it did not comply with the standard, and whether they would be kind enough to name some other water which could be consumed with greater safety.

The two reports which admitted of most comment were those of Mr. Dibdin and Dr. Klein, for they had set out their bacteriological figures in such detail as to enable a comparison between them to be instituted. Mr. Dibdin gave the following averages of the number of bacteria present in a cubic centimetre of water in the year 1895: Kent, 90; Southwark and Vauxhall, 352; Lambeth, 294; Chelsea, 139; Grand Junction, 170; West Middlesex, 130; New River, 130; East London, 277; unfiltered water at Sunbury, 16,061. Dr. Percy Frankland said he had no fault to find with these figures, as they were in substantial agreement with the results he had obtained with the same waters nine years previously. They indicated, moreover, that the waters were undergoing almost uniformly efficient bacteriological purification throughout the year. It was unfortunate, however, that Mr. Dibdin published the following average results, which he obtained in 1891-92: Kent, 4795; Southwark and Vauxhall, 4594; Lambeth, 4626; Chelsea, 3091; Grand Junction, 2612; West Middlesex, 2534; New River, 2299; East London, 3387; Sunbury, 179,601. Dr. Percy Frankland said that while he had no hesitation in accepting the previous figures, he was equally confident that the latter did not represent the average numbers of bacteria present, either in the river or in the waters distributed in the Companies' mains, over an entire year. He admitted that they might have been present during exceptional weather in winter; but they were not averages for the whole year 1891-92, either as regards the raw or the filtered river water, as, from the wording of the report, they purported to be. He pointed out, however, that, large as the figures were, they indicated a removal of from 97·4 to 98·6 per cent. of the bacteria by the purification processes to which the Thames water was submitted. But Mr. Dibdin drew conclusions from these two series of figures; for he said that they furnished "reliable data for comparison as to the bacteriological improvement which has taken place in the quality of the water between the years 1892 and 1895." This improvement he attributed to greater care exercised in the filtration; but he appeared not to have noticed that, according to his figures, the Kent Company's water, which was derived from deep wells in the chalk, and was not artificially filtered at all, had improved to a still more marvellous extent. Did he wish the reader to infer that even the chalk strata had been "pulling themselves together," and removing the microbes more perfectly through fear of the London County Council?

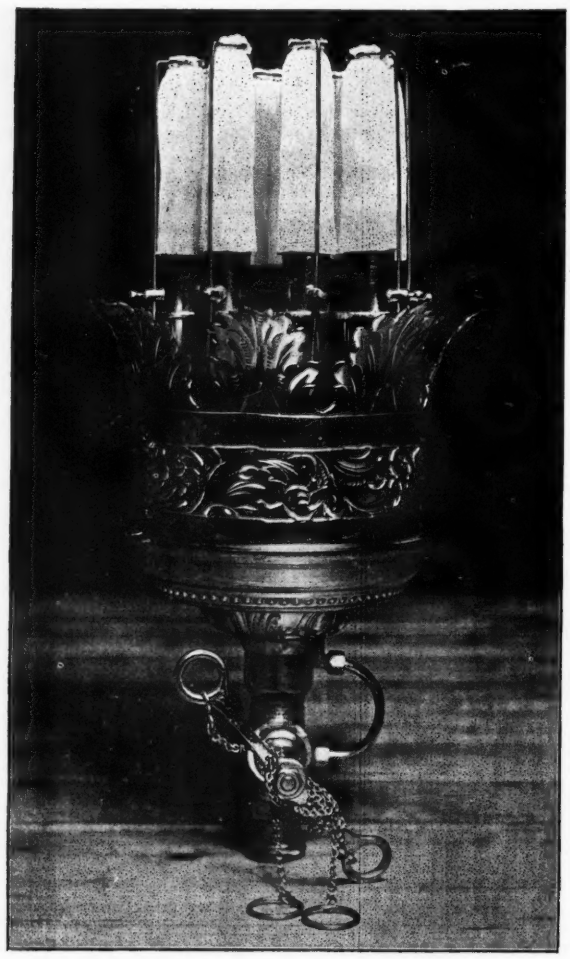
Turning to the report of Dr. Klein, the author pointed out that the figures published therein were more remarkable than those put forward by Mr. Dibdin; for where the latter found hundreds, the former succeeded in finding thousands of bacteria—the samples having been taken about the same time. The fluctuations among his own results were no less astonishing than the discrepancy between his figures and those of Mr. Dibdin; and here again it is the results obtained with the Kent Company's water which shake one's faith in their trustworthiness. In five out of eight samples of this water examined by Dr. Klein, he found upwards of 1000 bacteria in a cubic centimetre; and in one sample the number actually exceeded 20,000. How was it to be explained, asked Dr. Percy Frankland, that, if such a dense bacterial population was really present in this water, it entirely escaped the observation of Mr. Dibdin? But the startling novelty of Dr. Klein's discoveries could only be exceeded by the confidence with which he put forward his conclusions based upon his tabulated figures. From them it would, he said, be seen "that the number of bacteria per cubic centimetre was in very few instances below 100; this latter being the number above which the micro-organisms in drinkable water should not rise." He then catalogued the few instances in which the number found was less than 100; and he went on to say: "The other samples must be considered as containing a superabundance of microbes." Dr. Percy Frankland remarked that he could only assure Dr. Klein that neither these figures nor his *ipse dixit* would ever convince those who had even the most elementary acquaintance with the London Water Supply that the Kent Company, on the eight occasions on which his samples were collected, were sending out "undrinkable" water; nor would those who had a little more detailed knowledge of the subject give any credence to his statement that the waters of the West Middlesex and Chelsea Companies were "conspicuous by the excessive numbers of bacteria" they contained; for these were the very waters which had been over and over again shown to be the least densely populated with bacterial life. Dr. Percy Frankland went on to say that the publication of such flagrantly contradictory reports was not perhaps to be regretted on account of the injustice they did to the present London Water Supply; for the discrepancies they exhibited, and the fallacious arguments in which they abounded, led to their immediate public condemnation by all who had acquaintance with these matters. But he personally did deeply regret the issue of the document, as it must tend to bring public discredit upon a method of water examination the value of which it had taken years of patient labour to establish.

The author closed his paper by remarking that, from the account he had given of the bacteriological labours lavished on the subject of water supply during the past thirteen years, it would be seen that an enormous amount of new and important information touching the hygiene of water had been collected. This new knowledge had wrought a great change in expert opinion throughout the world; and this change of opinion had been greatest in respect of precisely that type of water which constitutes the major part of the present Metropolitan supply—viz., river water which has been subjected to storage and filtration. This bacteriological investigation had shown that river waters, by suitable storage and filtration, could be rendered of excellent quality for the supply of towns; and that the extent to which such surface waters could be deprived, by means of these processes, of their bacterial life, was altogether beyond what was to be expected. Careful search had also revealed the mechanism by means of which this remarkable purification was effected; it had shown what dangers this mechanism was exposed to, how the dangers might be guarded against, and the efficiency of the mechanism maintained and even improved. Bacteriology had thus become of priceless value to the water engineer, indicating the measures which must be adopted to secure the best possible result with the material at his command, and justifying him in the execution of those costly works in which every zealous water engineer delights, by enabling him to demonstrate, with a concreteness not before possible, the hygienic utility of his projects. But bacteriology had also furnished the public with a means of control, whereby almost the slightest negligence on the part of the water engineer could be detected, and the least irregularity in the purification processes exposed. That this new and delicate method of examination was liable to abuse, and that its results were capable of misinterpretation, was not surprising. It had, of course, like all the other delicate instruments which science has devised, *les défauts de ses qualités*. But this did not detract from its value; for surely, in the same way, it would be hypercriticism indeed to find fault with the chemical balance because its delicacy rendered it useless in the hands of a greengrocer or a coalheaver. The bacteriological investigator was generally regarded as a bird of ill-omen. He was certainly so regarded by the advocates of the present Metropolitan Water Supply when he first made his appearance. He was, however, in reality a friend in disguise; and the author thought there could be no question that they were the bacteriologist's revelations which called forth the dictum from the late Royal Commission: "We are strongly of opinion that the water, as supplied to the consumer in London, is of a very high standard of excellence and of purity, and that it is suitable in quality for all household purposes."

The Standard Oil Company.—Instead of the thirty separate organizations into which the Standard Oil Company is now divided, a single corporate union of them all is said to have been arranged, in accordance with a plan proposed a year ago. The capital, which is now $100,000,000, is to be doubled; and an agreement, says the "Financial News," is to be made with the Rothschilds and Nobels, who, as readers of the "JOURNAL" are aware, control the Russian oil-fields, for a friendly amalgamation of the two great concerns.

PHOTOGRAPHY BY DENAYROUZE BURNERS.

Visitors to the Pump-Room at Bath on the occasion of the meeting of The Gas Institute last week, were much attracted by the brilliancy of the group of Denayrouze gas-burners which had been fitted up there by the Denayrouze Light Syndicate, Limited. It was an exemplification of the fact that this burner lends itself admirably to grouping; and the powerful light produced by such combinations has been found to be well suited for photographic purposes. The burners may be placed in groups of three, five, eight, sixteen, or twenty; and the illuminating power of each burner ranges from 150 candles upwards,



according to pressure and consumption. The multiplication of the candle power by the number of burners would, of course, give the total light given by a particular group, but it would not adequately express its great penetrative capacity. The accompanying illustration has been produced from a photograph taken by an eight-light cluster, having a combined power of between 1150 and 1200 candles, and consuming only 70 cubic feet of gas per hour. The photograph was taken at night in a room measuring 38 ft. by 16 ft.; the cluster of burners being the only source of light.

The Position of the Nitrate Industry.—Referring to the prospects of the nitrate industry, which have been by no means rosy of late, a financial paper points out that nitrate has met with a very strong competitor in sulphate of ammonia, which is finding much favour with agriculturists; so much so, indeed, that the sale of that fertilizer has increased from 218,000 to 365,000 tons. At a meeting recently held in Valparaiso, at the instance of the Chilian Minister of Finance, to inquire into the causes of the depression in the nitrate trade, the conclusion was arrived at that, notwithstanding a reduction in freights from 25s. to 18s., nitrate was in less demand; and various measures were suggested to invigorate the trade—one being that the Chilian Government should spend an additional £15,000 in advertisements. Our contemporary doubts very much whether European agriculturists will be induced to purchase nitrate if sulphate of ammonia proves an equally good substitute at a lower price, even if the Government, which is already a very heavy loser owing to the restriction of the output of nitrate, should be disposed to find the money. The only resource for nitrate-producing companies under such circumstances is to seek new markets for their products.

CORRESPONDENCE.

We are not responsible for the opinions expressed by correspondents.

The East Dereham Gas Undertaking.

Sir,—In your "Journal" of the 15th inst., a report appears thus: "East Dereham Gas Undertaking. An Investigation into the Working." The figures were as given in a local paper, and were explained at the time to be a wrong statement—although not noticed by the reporter. In the first place it should have been 1895-96, instead of 1896-97. The quantity of gas made is quoted—viz., allowances for quantity sold, 9,217,300 cubic feet; escapes or leakages, 10 per cent., 1,200,000 cubic feet; unaccounted for, 1,147,600 cubic feet. As this appears to me as a report on a dereliction of duty on my part, I wish to make this explanation, and also give you correct figures.

In the first place, the registering of meters is vested in the surveyor of the town as gas collector; and I am therefore not responsible for that part of the business. The correct figures for the years are thus:—

Gas made, 1895-96		11,565,020 cubic feet.
Gas sold to private consumers.	8,573,300	
,, used in public lamps at 7 cubic feet per hour. . . .	1,108,260	
	9,681,560	,,
Gas unaccounted for		1,883,440 cubic feet.

No account was taken of gas used at works, council offices, fire brigade station, or the late surveyor's residence, whose widow is supplied with gas free.

Gas made, 1896-97		10,836,910 cubic feet.
,, sold to private consumers		9,125,100 ,,
,, used in public lamps at 6 cubic feet per hour		1,001,410 ,,
,, ,, at works	601,000	
,, ,, ,, offices	8,300	
,, ,, ,, fire brigade station	1,000	
,, ,, ,, surveyor's widow's	34,000	
	644,400	

This shows a leakage of 66,000 cubic feet on the year's working; and if the lamps are taken at 7 cubic feet per hour, as in the previous year, I am in the unique position of selling more gas than I have made—the lamps burning 166,900 hours during the lighting season. Under the circumstances as shown, 66,000 cubic feet unaccounted for gives me an unapproachable standing, which I know is impossible for our works to do—viz., of 0·60 per cent. of leakage.

Mr. Carr, of Widnes, holding a good record, I am quite desirous of wresting it from him; but I am satisfied I am not in the position to do so yet. Therefore, the figures as put before you may be seen at a glance to be all wrong. At the same time, I do not wish to show quite so bad a record as the report would indicate. Next Council meeting the figures will no doubt be put in proper form; and the local press will give the correct statement. Of course, I do not blame you, Mr. Editor; but these things look disparaging before one's brother managers.

A. Drage.

East Dereham, June 17, 1897.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS COMMITTEE.

Thursday, May 27.

(*Before Mr.* Rankin, *Chairman, Mr.* Reckitt, *Mr.* S. Smith, *and Mr.* Newdigate.)

NEW RIVER BILL.

This Bill, which is to empower the New River Company to construct additional works and raise further capital, came before the above-named Committee to-day.

Mr. Pope, Q.C., Mr. Littler, Q.C., Mr. Pember, Q.C., and Mr. Claude Baggallay appeared for the promoters. The other Counsel engaged were: Mr. Freeman, Q.C., and Mr. Russell Griffiths, for the Ecclesiastical Commissioners; Mr. Balfour Browne, Q.C., Mr. Worsley Taylor, Q.C., and Mr. Freeman, for the London County Council; Sir W. Marriott, Q.C., and Mr. Henriques, for the Corporation of London; Lord R. Cecil and Mr. Theobald Mather, for the Middlesex County Council; Mr. R. A. Read, for the Hertfordshire County Council; and Mr. Ram, for Grace Murray and others. Appearances were also reserved on behalf of the London and North-Western Railway Company, the Hertfordshire County Council, and Augusta de Wette.

Mr. Pope, in opening the case for the Company, said this was a Bill promoted for the purpose of utilizing completely the scheme which was authorized last year, under the title of the Staines Reservoirs Bill. That was a Bill promoted by three Companies—the Grand Junction, the West Middlesex, and the New River—and it was the first Bill which ever empowered the New River Company to draw water direct from the Thames. Under the Bill not only were the Staines Reservoirs sanctioned, but subject to certain restrictions as to the condition of the river, the mode in which the supply was to be taken, &c., the three Companies were authorized to abstract 35 million gallons daily from the Thames. The New River Company believed, when the Bill was being discussed, that they would be able to utilize this supply by the use of the pipes of one of the other two Companies; for, of course, in this district they had no mains of their own. It was found, however, that this was not practicable, or if practicable by no means the most convenient way to effect their object. Therefore the present Bill was promoted to raise capital to construct an aqueduct from the Staines Reservoirs to the New River Company's district of supply in the north of London. It was proposed to make subsiding reservoirs, filter-beds, and pumping-stations at Hampton, and thence to connect the aqueduct, the other extremity of which would be at Fortis Green. He did not think there would be any serious opposition to the works, the total cost of which would be about £970,000. The London County Council, he

believed, would ask the Committee to put upon the New River Company, in respect of the new capital which it was proposed to raise, in some form or another the sinking fund clause, which had of late been so frequently adopted. When this matter came to be discussed—and he had arranged with the representatives of the County Council that it should be argued separately—he should contend that the sinking-fund clause was not applicable to the New River Company as an undertaking, and that it should not be applied to this particular capital.

Mr. FREEMAN said that in the petition of the London County Council a considerable number of points of objection were raised, including this one as to the insertion of the sinking-fund clause in the Bill. He considered the latter matter of so great importance, that he would not intervene on the question of works; reserving himself wholly to the question of the sinking fund.

Mr. HENRIQUES said that was the course he should follow.

Mr. POPE proceeded to deal with the petitions. The Ecclesiastical Commissioners were the owners of the land through which the northern end of the aqueduct—which was really a closed pipe—would run underneath the ground. To maintain the purity of the water, there must be washing-out places, at which facilities could be afforded for flushing and cleansing the main; and the question to be decided in connection with the Ecclesiastical Commissioners was as to the placing of these wash-outs on their land in such a manner as not to unduly interfere with their property as a building estate.

Mr. FREEMAN said the points in respect to this matter were extremely few—being, first, that these little pipes, running from the aqueduct, should be carried under road sites, instead of through building plots; and, secondly, the Commissioners objected to the Company buying the land through which the pipes would run, instead of taking an easement only.

Mr. POPE said these were matters which would be explained by the Engineer. The Middlesex County Council, in their petition, wanted the Company to make provision for supplying the Local Authorities on the line of the aqueduct; but in reply to this, he pointed to the necessity that existed in the Company's own district for the whole of the water passing through the pipe. Then the County Council said the Company were seeking to acquire an unnecessarily large quantity of land; the object being to obtain common-law rights to sink wells without going to Parliament for powers. They overlooked, however, the fact that the Company must have capital to sink the wells, and that this capital could only be obtained by the consent of Parliament; so that there was no fear of Parliament not having control over them. As a matter of fact, the land sought was not excessive. They also objected to the wash-out pipes connecting with the River Brent; but Counsel suggested that the addition of the water that would be thus conveyed to the river, would be rather an advantage than otherwise. With regard to the petition of Grace Murray and others, the objections in which were similar to those of the Ecclesiastical Commissioners, he gave an assurance that the Company would do all they could to minimize the damage they did to any locality they had to deal with, whether by wash-outs or otherwise. In conclusion, he said that both the Act of last year and the present Bill were carrying out the recommendations of the Royal Commission on the Metropolitan Water Question.

Mr. *Joseph Francis*, M.Inst.C.E., Engineer to the Company, examined by Mr. PEMBER, said the New River rose at Chadwell Spring, and ran to London by a channel now 26, but originally 40, miles in length. All along the channel between Ware and London, were wells from which water was pumped into the river. The statutory quantity of water which the Company were entitled to take from the Lea was 22½ million gallons every 24 hours; the rest of their supply coming from 13 wells. The water from two of these wells was such that it could be distributed without filtration. The Company also had some well-ponds, which gathered surface water, and which had altogether a capacity of 29 million gallons. This water was only used for street watering and other non-domestic purposes; and entirely different pipes were used to convey it.

Mr. PEMBER: What is the maximum quantity of water per day upon which you can rely?

Witness: From the River Lea we get 22½ million gallons per day; from the Chadwell Spring and Wells, after making necessary allowances, 24 million gallons; and from the ponds, we might get about one-third of a million gallons—making altogether about 46¾ million gallons per day.

You have a table showing what your daily supply has been throughout the year?—Yes.

This table contains several columns. It shows that the average daily supply in 1883 was 28 million gallons, and in 1896 over 35 million gallons; that the average number of supplies given to various houses has risen from 138,000 to 160,000; that the average daily quantity per supply throughout the year has increased from 204 gallons to 222 gallons; that the estimated population supplied has risen from 1 million to 1½ millions; that the average daily quantity per head has risen from 27 gallons in 1883 to 33 gallons in 1895 and 30 gallons in 1896; that the average daily supply during the month of maximum consumption was 31 million gallons in 1883; and 43 million gallons in 1896; and that the average daily supply during the week of maximum consumption has risen from 33 million gallons to 45 million gallons?—Yes.

Witness, in further examination, gave other figures, showing that the number of constant supplies also had enormously increased. In estimating the needs of the Company, provision must be made for the time of maximum consumption—for the supply of a maximum week. This quantity had been as high as 45,641,000 gallons, which was perilously near the maximum quantity that was at their disposal. When the Bill of last year was before the Committee, evidence was given that, estimating the rate of increase of consumption to be the same as in the previous two years, in ten years from 1895 the average daily consumption throughout the Company's area would be 52 million gallons. But since provision was to be made for the maximum demand, 65 million gallons should be obtainable to meet the maximum consumption of 1905. If his prognostications were borne out, within the next ten years the Company would have to make up an increased supply of 18 million gallons a day. On particular days last year, the Company had had to supply as much as 48 million gallons. Last year a Bill was introduced by the Company asking for powers to raise capital for certain purposes. A portion of the Bill was approved; but part—notably that relating to the sinking of more wells—was refused. At the same time, the Staines Reservoirs Bill was promoted and sanctioned, the result of which was to give the Company power to take another 12 million gallons a day from the Thames. The Committee, on that occasion, said they could grant no further power as to taking water, owing to an Instruction which they had received from the House of Commons. In certain cases of emergency, the three Companies could, with the consent of the Local Government Board, increase the 35 million gallons to 45 millions. The report of the Commission of 1892 stated that the water, as supplied to consumers in London, was of a high standard of excellence and purity, and suitable in quality for all household purposes.

The CHAIRMAN: Is that in reference to the River Lea?

Mr. PEMBER: Both to the Lea and the Thames. The words are general.

Witness (continuing) said that under the Staines Reservoirs Act, it was supposed that the 35 million gallons of water would be drawn from the Thames by the two Companies; and that the New River Company would receive their proportion through the mains of one of these Companies. Since then this had been found to be quite impracticable; and in the present Bill, the clause relating to the taking of water was repealed. Under the present scheme, there would be two subsiding reservoirs at Kempton Park, near the racecourse, having a total area of 45 acres, and a capacity of 219 million gallons; also twelve filter-beds, of the total area of 9 acres. In addition, there was to be a small subsidiary reservoir for carrying the drainage, &c., to the Thames. After passing through the reservoir and filter-beds, the water arrived at the pumping-station, whence it would be pumped to an intermediate reservoir at Cricklewood. There would be all necessary works at Kempton Park, and pumping-engines of 623-horse power. The aqueduct would be 42 inches in diameter; and from Kempton to Cricklewood, its length would be 13½ miles. Along the route, it was necessary to have wash-out places—pipes which would be used for emptying the aqueduct, in case anything should go wrong with them, for cleansing purposes, or for alterations or repairs to be made. All these wash-outs would be made at depressions, and connected with natural water-courses; the level of the ground determining their position. At Cricklewood, there would be a reservoir and a pumping-station, which would have the effect of breaking and reducing the pressure there, which pressure would otherwise be entirely on one end of the pipe. The reservoir would be covered; and its capacity would be about 2 million gallons. The engines there would be of about the same power as at Kempton. At Fortis Green, 3½ miles from Cricklewood, the works would be similar to those at Kempton; and there it was intended to construct a reservoir holding about 15 million gallons.

The CHAIRMAN: What is your rise from Kempton Park to Fortis Green?

Witness: It is altogether about 260 feet.

Mr. PEMBER: That is the summit. After that, the water goes down by gravitation.

Witness (continuing) said they were at no place taking more land than was needed. The land actually required for the aqueduct was ½ chain in width; but 2 chains width was taken in the Bill, in order to give latitude in the laying. The cost of the land and works, according to the deposited estimate would be about £970,000. The estimates for the Kempton Park works were £429,858; for the main from Kempton to Cricklewood, £215,440; station and works at Cricklewood, £104,378; main from Cricklewood to Fortis Green, £67,964; reservoir and pumping-station at Fortis Green, £134,534; and the gravitation main, £18,340, or a total of £970,514. When the water reached the Company's present district, they would need to lay further mains to carry it to their other reservoirs. This work would be done under existing powers; but to cover the outlay, and some other minor expenses, the capital sought was put at £1,000,000. The line of aqueduct crossed several roads, but in no case passed over a road. The line had been taken from Kempton to Fortis Green across country, and not under existing roads, because of difficulties chiefly connected with the Local Authorities. As to the suitability of the soil at Kempton for reservoirs, he had had a number of borings made; and he found that there was a depth of from 10 to 20 feet of gravel resting on London clay, which was suitable for reservoir purposes. The only place where they interfered with any common land was at Hounslow Heath, where, with the sanction of the Board of Agriculture, they took only an easement. With regard to the request of the West London County Council, who wished the Company to give facilities for supplying water at a reasonable price to the Local Authorities whose districts the aqueduct passed through, he said the request was quite out of the question, because the Company required it all for their own district. The Ecclesiastical Commissioners wanted the main to be laid on lines where they eventually proposed to make roads; but the difficulty in connection with this was that, to place them so, would be to put them outside the limits of deviation.

By Mr. RECKITT: It was proposed to lay a main 42 inches in diameter. Two chains' width of land was taken, so that the Company might have power, if necessary, to put a second main down.

By Mr. FREEMAN: A 42-inch main would convey all the water the Company at present had power to take.

Friday, May 28.

On the resumption of the proceedings this morning,

Mr. *Francis*, in cross-examination by Lord R. CECIL, said the Company at the present time drew 24 million gallons of water daily from wells in the Lea Valley—it was the quantity on which they could fairly rely. If all the machinery were in order, they could get 34 million gallons. He thought 10 million gallons was a fair margin to allow for the stoppage of engines, and for the failure of any of the wells.

Lord R. CECIL: You have enlarged your wells in the Lea Valley since last year?

Witness: We are sinking one at Enfield, from which we expect to get 3 million gallons a day. The Company, he continued, would not get any water from the Staines reservoirs for seven years. The pipes to Fortis Green would not be laid for seven years; and the reservoirs would not be finished for six years. The pipes might be put down in three or four years, but not economically or conveniently in a shorter period.

Will you explain how it came about that you did not tell the Committee last year that you could not get a drop of water without a main of your own?—The matter had not been gone into thoroughly as it has been now. We were to bring the water through the West Middlesex or Grand Junction Company's pipes, if it were practicable. If it were not practicable, there was nothing to do but to go for fresh powers. After the passing of the Bill, we investigated the matter, and found that we could not get the water through either of the other Companies' pipes. We propose to take 15 years within which to complete the works, because it is not advisable that we should be compelled to do the whole of the work until we require the whole of the water. At the end of five or six years, it might be necessary to lay another line of pipes. The possibility of the Company being bought up has nothing to do with the present proposal.

You take power to send water into the Brent. Do you see any reason why this power should not be subject to the consent of the County Council?—The whole thing would be inoperative if consent was withheld. It is not proposed to discharge water into the Brent except when the main pipe was emptied for repairing or cleansing, &c.

You take power to buy a considerable quantity of land for the purpose of laying pipes?—Yes.

You have also constantly asserted that the New River Company have the same power of sinking wells in land belonging to them as private owners?—I suppose they have. The Company have acted on that.

For instance, the whole of the 13 wells in the Lea Valley have been sunk without any special statutory provision?—Yes.

Therefore the only restraint there is upon the Company sinking wells on any part of their land, is the amount of capital they may have to dispose of for the purpose—even if they do not use revenue?—Yes.

You will have, in fact, a considerable quantity of land which is not definitely applied to any of the purposes of the Act?—I think not.

You will have all the land that you will not require on each side of this pipe?—As a matter of fact, we only want a pipe-track ½ chain wide, and the limits of deviation show a track 2 chains wide.

There will be nothing to prevent you buying little pieces of land on the line of your pipes?—Nothing.

And in those spots you can sink wells?—I do not think it would be wise to do so, because it is an unsuitable position.

Do you not know that there are a great number of wells in Hanworth?—They are surface wells.

Assuming that they are wells through London clay into the chalk, why could you not have the same?—I do not think it would be a good position for a well.

Do I understand you to say that you do not propose, under the powers of this Bill, to sink wells?—That is so.

And do you object to that being stated in a clause?—I think there is a great objection to the Company's purchase of land being restricted in any way. If at Hanworth there were a number of deep wells, from which the district derived its supply, and the Company sank deeper wells and dried the others up, it might be a serious matter for the district. It would be very objectionable to have to supply the districts on the line of pipe, because the Company either required or would require the water for themselves.

Do you see any objection to this condition being imposed subject to the first right to the water being retained for the New River Company?—That would be absurd, because the New River Company's period of pressure would be the time probably when the districts would most require the water. Witness agreed that the great increase of water-drinking requirements was in the outer ring of London—such districts as the aqueduct would skirt.

By Mr. RAM (representing Mrs. Grace Murray and certain Trustees, the owners of an estate of 350 acres near Ealing): The estate might be called a building estate; but he objected to the Company being confined to taking an easement only of the land there, because there might be instances when they would want small plots of ground.

Mr. BAGGALLAY said the proposal of the Bill was that the Company should have power to take an easement only; but it gave the owner power to require the Company to purchase. It was to the interest of the Company—because it was cheaper—to take only an easement. But there were places where they must be able to take pieces of land to provide access to the mains, for wash-outs, making meter-houses, &c.

The CHAIRMAN: Do you not take power to purchase if you like?

Mr. BAGGALLAY: Yes; and we should have to have this power.

Mr. FREEMAN: It leaves it optional to the Company to purchase or not. They said they would take small pieces of land; but they should indicate the sites, because if they put an engine-house in the middle of his client's building land, it would be a fatal objection.

Mr. RAM (to witness): I understand you want a free hand right away from the river to Fortis Green in regard to the purchase of land?

Witness: Yes; to provide suitable places for air-valves, sluices, meter-houses, &c.

Mr. R. A. READ said witness had already admitted that the money of the Company was expended on buying land and sinking wells wherever they could. He proposed at a later stage to bring up an amendment allocating the money asked for strictly to the purposes of the Bill, and thus prevent the Company possibly from sinking any new wells in Hertfordshire.

Mr. LITTLER: We cannot sink wells in Hertfordshire without fresh parliamentary powers.

Mr. READ: I should be sorry to disagree; but the Company have claimed the power, and have done it.

The CHAIRMAN, after consulting with his colleagues, said the Committee thought Counsel would be in order in bringing up an amendment at the proper time.

Re-examined by Mr. BAGGALLAY: He (witness) was unable until the working plans were prepared to say where all the works on the line of pipe would be laid. If the Company could get their water through other Companies' mains, it would be to their interest to do so, as it would mean a great saving of expense. As a matter of fact, the water could be conveyed through those Companies' mains, but the supply would be unreliable. The amount of interference with the public roads would be very small. Once laid, the probability was that the main would not be interfered with for many years, though it might be necessary to duplicate it, because the present proposals might be regarded as the first instalment of the scheme suggested by the Royal Commission for obtaining a further large water supply.

Mr. BAGGALLAY: It has been suggested that you have certain powers of sinking wells. As a matter of fact, your object is to get water from the Thames, and as far as possible to save the necessity of sinking further wells?

Witness: Yes.

If you can get this water, it will reduce the probability of your having to resort to the chalk system of Hertfordshire by means of wells?—Yes. Witness added that the Joint Committee of the three Companies who controlled the Staines reservoirs had no powers of procuring water except those authorized under last year's Act. As to the opposition of the Ecclesiastical Commissioners, he had met their agent and agreed to certain points, but had been unable to come to a final settlement.

At this stage some conversation passed between Counsel on both sides and the witness, as a result of which it was understood that the opposition of the Ecclesiastical Commissioners was withdrawn—certain mutual concessions being made—except as regarded the right of the Company to take what land they required. This point was thought capable of arrangement; and it was agreed that it should be postponed till the following Monday, for both sides to confer regarding it.

Witness said in reply to Mr. RECKITT, the Staines Reservoirs Bill was only a part of the scheme contemplated by the Royal Commissioners. If that scheme were proceeded with, and further powers to take water from the Thames were granted to the Companies, it might be necessary, as suggested earlier, to lay a second line of pipes. There was no authorization in the present Bill to take more water.

Mr. *Elwell*, surveyor and valuer, said he had made a detailed valuation of all the properties required for carrying out the scheme, and of the capitalized cost of the easements; the total being £186,250. This was based practically on the assumption that the whole of the property involved would be purchased outright. He had no doubt the sum would be much reduced by many of the owners not requiring the Company to purchase absolutely.

This closed the case for the promoters.

Mr. MATHER then proceeded to address the Committee on behalf of the Middlesex County Council. He said it was not right to sanction the present proposals, because they might be as bad as the scheme of last year admittedly was. Mr. Francis said the present plan was practicable; but he was the only witness, and how did they know that he would not want to alter the scheme as in the case of the last one? He (Counsel) contended that they could not judge whether last year's scheme was good until the works had been constructed, and an attempt made to use the West Middlesex and Grand Junction mains. As to the River Brent, it was a stagnant river; and it seemed that if the output from the Company's mains was taken to that channel, there would be some danger to residents in the neighbourhood. He therefore thought that some control should be exercised over the Company in this matter. With regard to the power which their acquisition of land would give them of sinking wells, he urged that it should be limited as in the Act of 1896. In conclusion, he suggested the propriety of allowing the Local Authorities of the districts through which the pipes passed to have a share in any of the surplus water.

Mr. *S. Walker*, surveyor, then gave evidence on behalf of Mrs. Grace Murray and Trustees, with the object of showing that the laying of pipes on her estate, and the indefinite power sought of taking land wherever the Company thought fit, would seriously interfere with the due development of the locality as a building area. His chief objection was as to the Company acquiring portions of the estate instead of easements only; and he believed the damage done was such as an Arbitrator would be unlikely to fully appreciate.

Mr. RAM then addressed the Committee in support of Mrs. Murray's petition; contending that she should not be left merely to arbitration proceedings for compensation, but that her interests should be dealt with by clauses. He also asserted that the Company, without impairing the efficiency of their aqueduct, could materially lessen the damage threatened to be done to his clients' property, by certain alterations of the plans.

Mr. BAGGALLAY, in replying on the whole case, asserted that the circumstances as to what the effect of the Company's proceedings in connection with Mrs. Murray's property would be, were matters that should be dealt with entirely in arbitration proceedings under the general law. As to the suggestion, urged on behalf of the Middlesex County Council—that the Company should try to work under the arrangement of last year—surely, when they had an Engineer like Mr. Francis (who was supported by the Engineers of the Grand Junction and West Middlesex Companies) saying that this system of conveying the water was not, and would not be, satisfactory, it was unnecessary to wait six or seven years to prove in practice what they knew must be impracticable. They could not try the experiment till the reservoirs were constructed, which would be six or seven years hence. Then, when it failed, they would have to get the powers now sought; and so it would not be till, say, 1910 that the water given to the Company last year would be available. Regarding the River Brent, all that was contemplated was the emptying into it of the contents of the main whenever it had to be cleared to allow cleansing, repairs, junctions, &c., to be effected. There was really nothing in this objection. With reference to the allegations as to the Company sinking wells, he was prepared to take no authority under the Act to construct them; but he objected to the right of the Company to sink them being negatived. The right of the Company, which they possessed as ordinary owners, to sink wells was negatived in the Staines Reservoirs Act for an express purpose—namely, to prevent them from sinking wells on the banks of the River Thames. In conclusion, he said that, having regard to the proceedings in Committee last year, it was absolutely impossible to entertain the suggestion that the districts *en route* should be supplied. The surplus water could only be given for the first year or two; and it would always be irregular, and subject to being constantly cut off.

Monday, May 31.

On the Committee assembling,

The CHAIRMAN said he should like to see the sinking fund clause which it was proposed to insert.

Mr. BALFOUR BROWNE stated that he believed it was identical with the clause which was inserted in the Southwark and Vauxhall Act of 1894, and the Staines Reservoirs and the New River Acts of last year.

Mr. PEMBER said the position of the New River Company with regard to the clause was that it was, in the first instance, introduced as a temporary measure, because it was supposed that the purchase of the Companies by the London County Council or some other body was imminent. A number of Water Bills were then promoted, while the purchase idea was still existing; and in these Bills, consequently, the sinking fund clause in one form or another was inserted. The promoters, however, thought this era had now passed. If the Company were to exist for ever, there was no need for the sinking fund; and therefore they urged that Parliament should consider the present Bill with reference to there being no question of purchase at all. If the clause were inserted, he urged that it should be on the understanding that unless purchase took place, the sinking fund should be inoperative. In a Bill like the present, the sinking fund would be a very grievous burden and a grave injustice; for there was not the slightest possibility of the capital required for these reservoirs and mains returning a shilling of profit. The whole position of the New River Company was different from that of the other Water Companies. Its capital had never been ascertained; and it was not known at the present moment. In 1852, for certain reasons—but for no such purpose as this sinking fund—it was enacted that the capital was to be put at £1,500,000. In all probability, however, it was three times as much as that. People said the Company paid 12 or 13 per cent. But that was merely on the £1,500,000 of capital; and the effect of taking the dividend at that high rate, was to make the sum which would have to be set apart for the sinking fund, if the clause were granted, much higher than it otherwise would be, because the amount varied as the dividend rose or fell.

Mr. *James Searle*, Secretary of the Company, examined by Mr. BAGGALLAY, after giving evidence as to the necessity for the water which the present Bill would enable them to use, said the demand had very much increased of late; and every year for years past they had had to lay from three to four miles of mains to give new supplies. Witness gave a brief history of the Company from its incorporation in 1619 by Charter of King James I., ten years after the formation of the Company; supplying information as to the nature of the King's and Adventurers' shares, and as to the rights and privileges attaching to them. The government of the Company, he explained, was carried on by the possessors of not less than a complete 1-36th part of an Adventurers' share. The first Act was obtained in 1852, when the amount of capital deemed to have been invested in the undertaking was fixed at £1,519,958. The other capital of the Company was £500,000 in shares of £100, under the Act of 1866; £1,000,000 of 4 per cent. debentures raised under the Act of 1857; and £500,000 of 4 per cent. debentures raised under the Act of 1879. Then under the Staines Reservoirs Act of last year, a further sum was to be raised, of which the Company were to provide a third; and under the New River Act of last year, they had further capital powers as to £390,000, of which £120,000 had been raised. On the £500,000 of debenture stock, premiums amounting to £55,142 were received; and the £120,000 of last year, on which the interest was fixed at 3 per cent., went off at about £5 per cent. premium. The Company derived an income from some real estate in Clerkenwell, which was not required for the water part of their undertaking. The total dividend paid last year was £12 17s. 1d. There was no statutory limit to the dividend which the Company might pay. The expenditure on the proposed aqueduct and works would be no source of profit to the Company. The interest on the £1,000,000 which would be spent on them would be £30,000. The works would give no new source of supply, and no new consumers.

Mr. BAGGALLAY: In your opinion, will the application of the sinking fund in respect of the capital proposed to be raised impose a very heavy burden on the Company?

Witness: Necessarily it must. The Company must not only pay interest at about 3 per cent., but provide money for the sinking fund.

Mr. BAGGALLAY, in reply to the Chairman, read the section which it was proposed to introduce, and which was similar to the sinking fund clauses in earlier Acts. The effect of inserting it would be that, at the end of three years, the Company would have to average or equalize the whole of the dividends they were paying over the whole of the capital on which these dividends were paid. For the purpose of illustration, he would assume that it would work out at 8 per cent. They would take the interest on the £1,000,000—viz., 3 per cent.—and add to it 1 per cent. for management, making 4 per cent. The 4 per cent. would then be deducted from the 8 per cent., and the balance of 4 per cent. paid over to the Chamberlain of the City of London as the contribution towards the sinking fund.

Mr. BALFOUR BROWNE: That is a perfectly fair statement of the case.

Mr. BAGGALLAY added that he had not complicated the illustration by regarding the question of the premium at which the capital might be issued, nor by the effect of the real estate at Clerkenwell.

Witness (continuing) said the Clerkenwell estate had been acquired by means of the payment of a perpetual rent charge out of the property itself. Inasmuch as the Company could pay a higher dividend than other Water Companies, the contribution to the sinking fund would be higher. The expenditure of £1,500,000, which the capital of the Company was deemed to be by the Act of 1852, was made at a time when the value of money was very much less than at present. The capital value, as distinguished from expenditure, was much in excess of this sum; and the 12 per cent. which the Company paid was not therefore 12 per cent. upon the real capital value of the undertaking.

Mr. BAGGALLAY: Have you calculated, at the present rate of dividend, what the contributions to the sinking fund would amount to?

Witness: Yes; I estimate that if they go on paying their present rate of dividend, and when all the debenture stock has been issued under the two Acts of last year and the present Bill—that will be £1,723,000—they will have to contribute in respect of the sinking fund about £55,000 a year.

Mr. BAGGALLAY: And this would be in addition to a sum of between £50,000 and £55,000 a year payable for interest in respect of the same money.

The CHAIRMAN: Does the amount paid to the sinking fund affect the dividend next year?

Mr. BAGGALLAY: No; I think not.

The CHAIRMAN: Where do you get the £50,000?

Mr. BALFOUR BROWNE: Out of the consumers' pockets.

Mr. BAGGALLAY: It works very like the payment of income-tax.

The CHAIRMAN: Does it not operate upon the calculation for the next year?

Witness: Suppose at the end of the year you had £250,000, which in the ordinary way would be divisible among the shareholders, you would have to pay only such a sum as contribution to the sinking fund as, with interest, would make £250,000.

The CHAIRMAN: Supposing you actually earn 14 per cent., but can, owing to the operation of the sinking fund, only divide 12 per cent. Then the calculation next year would be upon a dividend of 12 per cent., and not upon one of 14 per cent.

Witness: I think it would depend upon what you could divide.

The CHAIRMAN: The calculation for this year's sinking fund is upon last year's dividend; and what I ask is this: Do you take for the calculation the dividend actually paid, or the dividend that might have been paid but for the sinking fund?

Mr. BALFOUR BROWNE: The dividend actually paid; therefore if there was any reduction, it would go into the calculation for the next year.

Witness (continuing) said the Company were asking to be relieved entirely from this clause; but if it were to be imposed, he certainly thought this was a case in which, as in the Staines Reservoirs Act, the contributions should run from the time the works came into use.

Cross-examined by Sir W. MARRIOTT: He objected to the clause being inserted in any Water Bill, as it imposed a burden—taking away money which would be otherwise divided among the shareholders. No doubt, the effect of the clause would be that, if the undertaking were ever purchased, the cost would be less than if there were no sinking fund.

By Mr. BALFOUR BROWNE: All water companies, save the New River Company, were limited as to their dividends; they could only increase them by reducing the price of water. There was no such restriction on his Company. The sum required under the present Bill for the sinking fund would be about £32,000. The New River dividends were steadily increasing. He agreed that the effect of the sinking fund was similar to that of the sliding-scale in connection with gas companies; being in the nature of profit-sharing with the public. He was aware that the Board of Trade had reported on the present Bill.

Mr. BALFOUR BROWNE read extracts from the report, in which the Board of Trade pointed out that this clause had been inserted in recent Acts relating to water companies, and expressed the opinion that the same course should be followed in regard to the present Bill.

Re-examined by Mr. BAGGALLAY: No doubt, if the charge for the sinking fund had to be provided, the rates to consumers would be increased so as to provide this extra sum.

Mr. BAGGALLAY: Do you know whether there is any case, in the whole of the United Kingdom, out of the Metropolis, where a sinking fund clause such as this has been introduced?

Witness: No; I am not aware of anything like it.

Sir W. MARRIOTT then addressed the Committee on behalf of the City Corporation. The question, he said, was whether this clause, which applied to all the other London Water Companies, and was applied to this Company last year, should or should not be inserted in the present Bill. Parliament had decided that while the question of purchase was in suspense, any powers given to Water Companies should not increase the selling value of the undertaking to the public. It was for the promoters, therefore, to show that there were such exceptional circumstances in this case as would justify the Committee in departing from this ruling; and he held that they had not done so. Without the works for which power was sought in this Bill, the Company could not carry out the duties imposed upon them by Parliament. If that was so, it was part of the concern producing gain. It was not for the Committee to say which was and which was not productive. The London Water Question was referred to a Commission, who were to report if possible before the County Council elections of next year. At a time, therefore, when the matter seemed to be within measurable distance of being settled—probably by the Companies being allowed to keep their concerns as at present, but under much more stringent control, or by some public body or trust taking them over—the New River Company came and asked for this exemption. The point seemed unarguable; and he should not therefore trouble the Committee with further observations.

Mr. BALFOUR BROWNE urged the Committee to direct the insertion of the clause for the reason that, if they omitted to do so, the expenditure of this million of money would certainly enhance the value of the undertaking to an enormous extent when, as seemed certain, the County Council, or some other trust or body, came to purchase it; because even if the expenditure did not increase the revenue, it would give infinitely greater security. The clause had been put in the Staines Reservoirs Act; and the present proposals were an integral part of the scheme proposed under that Act. Why, therefore, should the capital involved in it be exempted in the one case any more than in the other?

The room was then cleared. On the re-admission of the public after a lengthy interval,

The CHAIRMAN said: The Committee have decided that the preamble of this Bill is proved. They have also decided that a sinking fund clause is to be inserted, on the principle of clause 81 of the Staines Reservoirs Act of 1896; that easements only are to be taken over Mrs. Murray's property, except so far as the lands required for meter-houses and other works are concerned; that plans and sections must be given within five years to all from whom easements are taken; and that a clause is to be inserted in the Bill specifying the works to be undertaken, and allocating the capital necessary to carry out these works.

It was then arranged that the clauses should be taken at a later sitting of the Committee.

Mr. PEMBER remarked that it was understood that, if the promoters were not able to make the changes which had been agreed upon with the Ecclesiastical Commissioners, in consequence of the Commissioners not putting them in a position to do so, the Bill would proceed as it stood.

Thursday, June 3.

The Committee this morning considered the clauses of the Bill, and the various amendments and additions rendered necessary to comply with the terms of their decision.

It was proposed to add to clause 9, which gives power to acquire and use lands, the following words: "But nothing in this Act shall be construed to empower the Company to take any of the waters in, under, or

on the lands authorized to be acquired by them under this Act within a distance of one mile from the River Thames."

Lord R. CECIL asked the Committee to strike out the last words of the proposed addition—viz., "within a distance of one mile from the River Thames." If the Company had power to sink wells on the line of pipes, they might intercept water which would otherwise flow into the Thames or Lea, and thus interfere with the statutory obligations placed on the Company to take only a certain quantity of water from the river. The effect might be that the flow of the river would be diminished. A similar clause had been inserted in the Staines Reservoirs Act.

Mr. PEMBER said the matter was argued on preamble. He objected strongly to any right the Company might have of sinking wells being reserved. In the Staines Act, the area of land was much nearer the river; and, moreover, the Joint Committee under the Act were not forbidden to sink wells, but only from raising water for purposes of sale.

Lord R. CECIL intimated that he would be quite content to take the same clause in the present Bill in relation to this matter, as appeared in the Staines Act of last year.

After further discussion,

The CHAIRMAN said the Committee were of opinion that the clause and the addition as proposed by the promoters afforded sufficient safeguard; and that therefore it should stand.

Mr. POPE then brought up the following clause, in connection with Mrs. Murray's property:—

Easement only to be taken in lands of which Grace Murray is tenant for life. As regards any lands in the parishes of Perivale and Greenford, in the county of Middlesex, of which Grace Murray is now tenant for life under a settlement, the present Trustees of which are Thomas Denman Croft and Major Edward Croft Murray, the Company shall not, unless otherwise agreed between them and the said Grace Murray or other the tenant for life of such lands and of the Trustees under the said settlement, purchase or take any of the said lands, except for the erection of meter-houses or for works other than the laying down of any aqueduct conduit or line of pipes, but may acquire an easement only in such lands; and the provisions of the section of this Act of which the marginal note is "Power to acquire easements only" shall apply to and in the case of the easement so to be acquired.

Mr. RAM wished the clause to be amended, to the effect that in selecting sites for such meter-houses or other works, the Company should agree the site with his clients, or that the matter should be decided by arbitration.

The CHAIRMAN said the Committee thought the clause as presented by the promoters carried out the intention and judgment of the Committee. The clause, without amendment, would therefore be accepted.

Mr. RAM pointed out that it was admitted by Mr. Francis, the Engineer to the Company, that there would be no objection to his clients making a road over the line of pipes. This power was not contained in the clause: and he asked that words be added giving the right.

It was agreed that the power sought should be granted.

Mr. RAM further reminded the Committee that in the early part of the case he raised the point as to the rights of his clients in developing the estate after the aqueduct had been laid. He wished provision to be made so that if in future any extra cost were incurred in setting out the estate, consequent on the laying of the aqueduct, the Company should pay to the owners extra compensation.

Mr. POPE held that such an item would be included in the arbitration in the first instance.

The CHAIRMAN said the Committee were of opinion the contention was a just one, if it was limited to a certain time; and they thought a limit of ten years from the laying of the pipes ought to be a sufficient time.

Lord R. CECIL asked for clauses giving the same protection under the present Bill in regard to roads and bridges in Middlesex, as was granted under the Staines Reservoirs Act.

Mr. POPE agreed to the insertion of the clauses.

The following clauses were then agreed to without discussion:—

Plan and section to accompany notice to treat where easement only taken. Where the Company under any of the provisions of this Act acquire an easement only in any lands, the notice to treat in respect of such easement shall be accompanied by a plan and section showing the lands in which the easement is to be taken, and the level of which the aqueduct, conduit, or line of pipes for the purposes of which such easement is to be acquired is intended to be laid; and the Company shall not, in the execution of the works, deviate from the level to be shown on the section so accompanying the said notice to treat.

(1) Creation of sinking fund. At the end of the half year in which the Company first supply water to their consumers by means of the works by this Act authorized, and at the end of each succeeding year, the Company shall carry to a sinking fund such percentage on the amount of debenture stock then issued under the powers of this Act and of any premiums received thereon as shall be equal to the excess of the average percentage of the dividend or interest paid for that half year or year on all the capital of the Company, whether ordinary or preference stock or debenture stock, including the capital sum of £1,519,958 mentioned in section 4 of the New River Company's Act, 1852, with any premiums received thereon above the rate of interest at which the debenture stock under this Act was issued, together with an additional 1 per cent. per annum added thereto for management; such sinking fund to be held and applied by the Chamberlain of the City of London as trustee, for the purpose of purchasing and holding stock of the Company, and of investing the dividends thereon with a view to ultimately extinguishing the capital of the Company, or for such other purposes as Parliament may from time to time determine. No stock so purchased and held shall confer any right of voting at any meeting of the Company. Provided that, in the event of any debenture stock created under this Act being issued below par, the percentage to be carried to the sinking fund shall in respect of such debenture stock so issued below par be calculated on the amount of money raised by such debenture stock instead of on the nominal amount of such debenture stock.

For the purposes of the above provision, any sums paid by the Company by way of dividend or interest out of income derived from freehold or leasehold estate or property shall not be reckoned, included, or taken into account;

(2) In the event of the undertaking of the Company being acquired by a public authority, the allowance of 1 per cent. for management shall not be deemed to have increased the capital value of the undertaking or be the subject of compensation or purchase.

Mr. RAM, at a later stage, asked the Committee to grant his clients their costs; but the application was not acceded to.

The Committee subsequently reported to the House that a report from the Local Government Board had been referred to, and considered by, them; and that they had inserted a provision in clause 7 of the Bill, as recommended, requiring the Company to make full compensation to any person injuriously affected by the exercise of the powers sought by that clause. With respect to clause 31, referred to in the report, estimates of the proposed works were laid before the Committee; and it appearing that no more capital was asked for than was necessary for the purposes of the works and for the costs of the Act, and that the whole of the works formed part of one scheme, the Committee considered it unnecessary to allocate portions of the capital to particular works; but they struck out of the clause as to the application of the capital the power to apply any part to the general purposes of the Company. The Committee, in pursuance of the recommendation of the report, inserted a clause requiring the formation of a sinking fund, adopting the basis of the sinking fund provided for by the Staines Reservoirs Act, 1896, in the case of the Company and of the two other Water Companies who promoted the Bill for that Act.

LEGAL INTELLIGENCE.

Annoyance Caused by a Gas-Engine.

At the Norfolk Assizes on Tuesday, before Mr. Justice Mathew, the case of *Plowright v. Collinson and Another* was heard. It was an action by the plaintiff to recover from the defendants damages alleged to have arisen from the use of a gas-engine at their works in Tower Street, King's Lynn. The plaintiff owned and occupied a house which was only separated from the works by a passage; and the complaint was that, since the substitution of a 16-horse power gas-engine for a 6-horse steam-engine, the place had been unbearable. An injunction had been granted by Mr. Justice North; and this had resulted in a mitigation of the nuisance. But plaintiff was still unable to enjoy his property as he was entitled to do; and he asked to be compensated for the damage he had sustained. For the defence, Mr. W. H. Wheeler, M.Inst.C.E., was called, and stated that he visited the premises in question last December, and again on the 9th inst., and there was practically no noise in the engine-room—certainly not sufficient to cause nuisance to anybody. On the latter occasion, he also went over the plaintiff's house when all the machinery was running; and he only noticed vibration when he put his back against the wall. A very subdued rumbling noise could certainly be heard; but it was nothing more than a person would get accustomed to in a few hours, and could not be called a nuisance. His Lordship asked whether, if the two houses were put side by side in the country, away from all other noises, the sound would be a nuisance. Witness replied that it might be. His Lordship, in summing up, commented on the fact that the defendants had not made any attempt to meet the plaintiff when he first complained. The Jury found for the plaintiff, with £5 damages and costs.

Surplus Water from Hucknall for Nottingham.—The Nottingham Corporation recently inquired of the Hucknall District Council the terms on which they would sell to them in bulk such water as they could spare. The Water Committee of the District Council have informed the Corporation that they would be willing to sell the surplus water at the expense of such preliminary inquiries and expert reports as are necessary to ascertain the feasibility of the Council granting the supply.

The Defective Reservoir at Redruth.—The Local Government Board have refused to sanction the proposal of the Redruth District Council to raise a loan to cover the cost of rendering the leaky reservoir water-tight. At a meeting of the Council yesterday week, the Clerk said he had written to the Board with regard to their refusal; but they continued firm in their decision not to sanction a loan for the purpose. The Chairman (Mr. A. Lanyon) said the action of the Local Government Board was monstrous. A further attempt is now to be made to induce the Board to relent; and the local member of Parliament, Mr. Strauss, is to be invited to assist in putting pressure upon them.

The Capabilities of the Halifax Water-Works.—The Water-Works Engineer of the Halifax Corporation (Mr. J. A. Paskin) has presented a report to his Committee as to the capabilities of the present water-works. He draws attention to the fact that the works are now barely sufficient to supply their wants, and says that, if the various out-districts demanded the quantities of water granted them by Parliament, the works would be insufficient. He urges that, in estimating the value of the works in point of volume, the same circumstances apply to-day as in 1865, when Mr. Bateman reported as to gauging the capacity of the works. In using the term "a dry year," he explains that he does not mean a year in which the least rainfall takes place over the whole twelve months; but a year when plenty of rain falls in the early portion—say, to the end of March—and little from March to October; the reservoirs overflowing up to the end of March, and being replenished from October to December. The overflow from November to the following March is of no avail for the town's supply; but possibly the rain return for the whole year might entitle it to be classed as a wet year. The value of a water system cannot be based on the rainfall where there is insufficient storage; and this is the case in Halifax and other towns where the whole rainfall is not impounded. The safer plan is to take the actual storage provided, added to what may be considered as the average yield of the streams during a drought in the district for 220 days. This he works out as follows: Storage, 1346 million gallons; average yield of streams for a drought of 220 days, 694 millions—total, 2040 million gallons. Deducting compensation to mills, 4,050,000 gallons per working day, or 190 days out of 220 (769½ millions), leaves for the town 1270½ million gallons. The rate at present registered for 220 days, at 4¾ millions per day, is 1045 million gallons; so that there is a balance of 225½ million gallons. The reservoirs could not be drawn to their lowest depths; and a fair average would be to deduct 10 per cent. for silting and dirty water; so, from the 225½ million gallons must be deducted 134½ millions—leaving 91 million gallons, or about nine days' supply. Considering that the new works will take five years to construct after the Act is obtained, no time should be lost, Mr. Paskin urges, in extending the works.

MISCELLANEOUS NEWS.

THE GAS QUESTION IN VIENNA.

The report of a meeting of the Vienna Town Council on the 28th ult. in a number of "Der Gastechniker" just to hand throws a somewhat lurid light on the attitude of the anti-Semitic party, which is now in the ascendant on the Town Council, towards the Imperial Continental Gas Association. Dr. Lueger, who is the leader of the party, reported that an offer had been made by the Association to hand over on July 1, 1898, the whole of the gas-works in the nineteen districts, and the mains, lanterns, meters, &c., within the commune, for the sum of 16,500,000 florins (about £1,375,000). The Gas Commission of the Council recommended the rejection of the offer, and suggested that overtures should be made for a reduction of the amount to 12,000,000 florins. To this the Association would not consent. The town was now pledged to expend 16,000,000 florins on its own works, and the offer of the Association was therefore rejected. Dr. Vogler strongly objected to the attitude of the majority on the gas question; and, on behalf of the minority, he repudiated responsibility for the action of the Council in the matter. He considered that insufficient information had been given to enable the subject to be properly discussed, and that the members of the majority appeared content to remain almost unacquainted with the facts. Before the offer of the Association was rejected, a calculation should have been made as to the value of the meters, &c., and the offer considered on the basis of such an estimate. It was stated on Dec. 18, 1896, that offers made by the Association would not thereafter be considered; yet the Council were now informed by the Burgomaster that there had been negotiations continually since that date. It had been impossible to give the question the conscientious consideration that its importance demanded. Herr Gaugusch spoke in a somewhat similar strain; and Dr. Lueger then defended the action of his party. He considered that the town would benefit by the possession of new works, as the old ones would need reconstructing if purchased. The Council did not, however, wish to contest every point with the English Association, and were desirous of facilitating a peaceable termination to the negotiations.

THE WIRE-ROPE GUIDED GASHOLDER AT PERTH.

Inaugural Ceremony.

The formal ceremony of turning on the gas to the new holder which has been erected at Perth on Pease's wire-rope guided system took place last Wednesday. The holder is situated at the Upper Harbour, about 50 yards from the banks of the Tay, which, by the way, on account of the exceptionally heavy rainfall of the previous night, was on Wednesday rolling in high flood, 10 feet above the normal level. Doubtless the tempestuous nature of the weather prevented a number of gas managers from being present. Among those who were able to attend were Mr. T. Whimster, late Engineer to the Perth Gas Commissioners, Mr. P. B. Watson, of Falkirk, and Mr. A. Waddell, of Broughty Ferry. There were also present, Mr. A. Wilson, the present Gas Engineer at Perth, Mr. D. Easson, the Assistant-Manager, and Mr. G. Lindsay, the Treasurer to the Gas Commission, besides nearly all the members of the Commission and a number of friends.

The holder stands upon ground which belongs to the Gas Commissioners at the southern end of the public park known as the South Inch. Beside it is a holder which was erected only a few years ago, according to designs prepared by Mr. Whimster, and which is one of the most beautiful holders to be seen anywhere. The station is well sheltered by trees and buildings, and thus the wind strains are not likely to be so powerful as to test the rope-guiding appliances. Four ropes are used, giving eight equidistant points of support. They are applied to the outer lift on the double-purchase method, which is the latest improvement of the Pease patent. The holder is a double-lift one—the outer lift being 123 feet in diameter and 25 feet deep; and it is of 650,000 cubic feet capacity. The crown is untrussed; and when down it rests upon a wooden framing. The tank is of steel. It is 26 ft. 6 in. deep, and 125 feet in diameter. It is sunk in the ground to a depth of about 6 feet. The soil excavated was first sand and then gravel. A bed of concrete, a foot thick, forms the foundation for the tank; and it is lined up the outer side with brick, as a protection. The excavation and the brickwork were executed by local contractors; and the tank and holder were erected by the patentees, Messrs. Ashmore, Benson, Pease, and Co., Limited, of Stockton-on-Tees, whose representative (Mr. W. F. Smithers) was at the inauguration.

Bailie Wright, the Convener of the Works Committee of the Commission, opened the proceedings by a reference to Lord Provost Dewar's unavoidable absence; and he then called upon his wife to turn on the gas. Mrs. Wright, with the assistance of Mr. Wilson, gave the few turns necessary to open the valve. Bailie Taylor, in the name of the Commissioners, presented Mrs. Wright with a silver-gilt key, bearing the City coat of arms and a representation of the holder, with an inscription, as a memento of the occasion; and Bailie Wright, on behalf of his wife, returned thanks for the gift.

On the invitation of the Lord Provost, the company adjourned to a marquee which had been erected close by, and partook of refreshments. His Lordship was able, shortly after the proceedings began, to join the party and to take the chair.

Ex-Provost Whittet proposed the toast of "The Perth Gas Commission." He remarked that the holder which was at the moment going down while the new one was going up was erected during his reign. He had known the Perth Gas Commission for a very long period; and he believed everyone who was acquainted with it would endorse his statement that it had been one of the best-conducted and most profitable undertakings under the charge of the Municipality of Perth. It had grown by leaps and bounds. During the whole of its existence it had had very substantial balance-sheets; and it had now found it necessary to erect the magnificent gasholder they had seen inaugurated. He thought it said a very great deal, not only for the Convener of the Works Committee, but also for their excellent and able Gas Manager, that it had become an accomplished fact. It seemed to be of the very best workmanship; and he hoped it would fulfil all the duties required of it until the gas-works again required an extension of storage.

Bailie Wright, in acknowledgment, said that gas was originally introduced into Perth by Dr. Adam Anderson, who also brought the water system into the city. Gas was first used in 1824. Before it was introduced, all the light they had in the streets of Perth was a solitary lamp at the corner of each street; now they had something like 1200 lamps. The capital of the original Gas Company, formed in 1823, was £10,000; and by the time their new holder was completed, and the governor attached to it, the Gas Commissioners would have spent £10,000 upon what was merely a little addition to their works. In 1873, when the town acquired the undertaking, the make of gas was something like 40 million cubic feet; whereas last year they made 124 millions. During the first twenty years of working in the hands of the Municipality, progress was made at the rate of a little less than 3 million cubic feet per annum—the actual increase having been 58 millions. During the last three years, it had been 28 million cubic feet; so that, if maintained at the same rate, in six years they would have made as great progress as they did in their first twenty years. In addition to this, the Commission had spent £50,000 in extensions since the gas-works came into their hands; and at the present time, including the new holder, they would not have more than £15,000 or £16,000 of debt. One very important matter in connection with this additional holder would be that Sabbath labour in the gas-works would be almost given up. He supposed that gas engineers a few years ago would have thought this impossible; but they were hopeful that now their employees would be able to enjoy their Sabbath rest, like other people. It would not be much advantage to the men in the matter of wages; but they knew that the men were perfectly pleased with the prospect. If for nothing else, the erection of this holder would be worthy of their doing. He knew that some people thought the Gas Commission did not pay off sufficient debt. Time after time they had the gas annuities dangled in their face; and they were told that they ought to clear them off. He himself once thought so; but he had not been very long a Convener of the Gas Commission before he discovered that it was far better to let the annuities remain than to seek to buy them up. When they took over the undertaking, as much as 1s. 8d. per 1000 cubic feet was required to pay the annuities. This year it would be reduced, simply by the large increase in the consumption of gas, to 5½d. The greater the consumption of gas, the smaller would be the sum payable for annuities; and it would be easier for gas consumers than if they were to be charged with the cost of buying up the annuities, and those who came after them were to be entirely freed, which he did not think was a good policy. Within the last three years they had been able to take 7d. per 1000 cubic feet off the price of gas, and to abolish meter-rents, which was a great boon to poor consumers.

The Town Clerk (Mr. W. M'Leith) proposed "The Town and Trade of Perth."

Mr. R. D. Pullar acknowledged the toast. He said there were many ways in which the trade of a town might be measured; and the consumption of gas was a very fair indication of it. He was very glad to know that in Perth this was increasing. It was due from the traders of Perth to thank the Gas Commissioners for the trouble they took to supply gas as good as it could be made. There were now so many trades dependent upon gas, that it was desirable that it should be sent out of the best quality.

Bailie Wright proposed "The Contractors."

Mr. Smithers, in acknowledging the toast, apologized for the absence of Mr. Benson, their Managing-Director. He said they had now more than fifty gasholders in all parts of the world erected on the wire-rope system, and they had had no complaints regarding any one of them, excepting that at Middlesbrough; and with reference to this they had undertaken to replace everything in connection with the patent which required to be replaced in that holder, and to renew their guarantee. They were so thoroughly satisfied with the working of the system that they felt justified in taking this course.

Ex-Lord Provost Martin proposed "The Gas Officials."

Mr. A. Wilson, in responding, said that when he went to Perth he was practically an untried man; but the Commissioners had shown confidence in him, and his work had been a pleasure to him.

Lord Provost Dewar proposed the health of Mr. Whimster, who, he said, served the community of Perth as Gas Engineer, first with the Company and afterwards with the Gas Commission for fifty years, and the fruit of whose labours no doubt the present Manager was reaping.

Mr. Whimster thanked his Lordship for the kind words he had used, and the company for the way in which they had received the toast. He said it gave him great pleasure to see the progress made by the gas undertaking since he left. He thought it was the right thing to select the form of holder they had adopted, as by so doing they had saved perhaps £2000 or £3000.

As the party broke up, it was observed that the new holder had, in the course of an hour, risen by nearly half its height; and the foreman reported that it was going up without a hitch.

GAS SUPPLY IN THE OUT-DISTRICTS OF MANCHESTER.

The Differential Charge.

Representatives of the out-districts of Manchester had an interview with the Gas Committee of the Corporation last Tuesday, for the purpose of urging the abolition of the differential price for gas supplied to the townships and also the abolition of meter-rents. The deputation was composed of gentlemen from Withington, Gorton, Northenden, Audenshaw, Moss Side, Stretford, Levenshulme, Cheadle, and Gatley. Alderman Gibson, the Chairman of the Gas Committee, in receiving the deputation, said Manchester and the out-townships were practically brothers; and the Committee had always proceeded on the assumption that what was good for the one was good for the other, and *vice versâ*. Their desire was to do the best they could for all their customers, no matter whether they resided inside or outside the city. Mr. John

Slyman (Stretford), in introducing the deputation, remarked that, smarting under heavy gas bills, and knowing that the Corporation made a very large profit from the gas-works, the out-townships had determined to approach the Committee in a united and conciliatory manner, with the view of securing the removal of existing grievances. Mr. J. Swarbrick (Withington) said the deputation practically represented the whole of the ten out-townships that were supplied with gas by the Corporation, which out-townships had a population approaching 100,000, and something like 18,000 gas consumers. The injustice now complained of was one of long standing. It was in 1859 that the differential charge for gas supplied to the out-townships was first imposed. Perhaps it was not unreasonable under the circumstances of that time that consumers in the outside districts should pay (say) 10 per cent. more for their gas than consumers within the city; but now that the out-districts were densely populated, with consumers living closer together, the reason for a differential rate did not exist. Yet the differential rate was the same now that gas was selling in the city at 2s. 3d. as it was when the price was 5s. Consumers north of the Mersey were still charged 6d. per 1000 cubic feet extra, or 22 per cent. more than those in the city; while in Northenden, Cheadle, &c., 1s. extra was charged. This was not as it should be, having regard to the fact that, in the case of Birmingham, Oldham, and other Corporations, Parliament had distinctly set its face against such differential charges; and Salford, too, was being compelled to give way on the point. The Corporation were making considerable profits out of their gas undertaking, and could well afford to do the act of justice which was now solicited. Other members of the deputation having spoken in a similar strain, Alderman Lloyd Higginbottom, formerly Deputy-Chairman of the Gas Committee, said he was quite willing to admit that Parliament would not now give them leave to charge a differential rate between inside and outside consumers; but it must be remembered that Manchester worked under an old Act, and had its own rights. The deputation was already assured of the sympathy of the Chairman of the Committee, who in 1895 submitted to the Council a proposal for the reduction of the price of gas to the out-townships and the abolition of meter-rents. The Council rejected the proposal. It was an inopportune time for the out-townships to come making these requests when they were taking power to instal the electric light, which would be a rival of the gas supply, and would diminish the revenue of the Gas Department. Two of the out-townships, he was glad to say, were taking their supply of electricity from Manchester. The aims of the deputation had nevertheless his hearty sympathy; and he hoped the Gas Committee might be disposed to go some distance at least in the desired direction. Alderman Gibson said that, so far as he was individually concerned, he was in sympathy with the objects of the deputation. Twelve months ago, he submitted to the Council a resolution of the Gas Committee—not a unanimous resolution, however—in favour of a reduction of 3d. in the price of gas supplied to the out-townships and the abolition of meter-rents, as he quite recognized that it was manifestly unfair to have the same differential rate now that gas was selling at 2s. 3d. as when it was sold at 5s. He was pleased to tell them that the Gas Committee at their last meeting had again decided—and on this occasion unanimously—in favour of the concessions formerly recommended to the Council; and now that the Committee were unanimous, he had the fullest hope that the Council would accept the proposal. But he could not court defeat by going to the Council and asking that the whole of the differential rate should be abolished. The Committee thought their proposal was a fair and equitable one; and they hoped it would be accepted in that spirit by the City Council and by the out-townships. A differential rate of 3d. would be a very small thing for the out-townships; and it would make a difference of about £9000 to the revenue of the gas undertaking. Regret was expressed by some of the members of the deputation that the Committee did not propose the abolition of the whole of the differential rate.

THE PROFITS OF THE TRADING DEPARTMENTS OF THE BRADFORD CORPORATION.

A statement on the finances of the borough was made, at last Tuesday's meeting of the Bradford Town Council by Mr. H. B. Ratcliffe, the Chairman of the Finance Committee. In the course of his address, he referred to the monetary affairs of the water, gas, and electricity departments. Speaking first of the water accounts, he said that the gross receipts in the past twelve months amounted to £138,097; and the payments to £149,921—a loss on trading of £11,824. This was after taking the fullest advantage of the conversion of stock effected two or three years ago, which affected beneficially the water-works trading account by about £7000. Had it not been for this, the loss would have been nearly £19,000. Referring to the coming twelve months, Mr. Ratcliffe said that the Council had been bold enough to leave outside the provision of the sinking fund a little over £8000, which they hoped would be granted to them when they were before the Committee of the House of Commons with their Bill. Taking this into account, and the debit balance of £9380 at present due to the bank, and the estimated requirements and receipts for the coming year, it was estimated that the sum of £11,237 would be required in order to make the account balance. The Committee asked the Council for £3000 from the accumulated gas profits, reducing the amount to £8237; and it was estimated that a 2d. rate would then be sufficient for water-works purposes. It might be interesting for the members to know something of the progress of the water rents. From 1886 down to the present time, there had been a steady and continuous advance in the domestic rental rising from £45,845 in 1886 to £58,046 last year; and the consumption through meters had increased from £51,212 in 1886 to £70,218 last year. In connection with the new water-works in the Nidd Valley, the amount spent on capital account up to March 31 last was £477,000; and the estimate for the year ending March 31 next was £125,000—making a total of £602,000, towards which the Corporation had borrowed by the issue of debenture stock £500,000. It would therefore be necessary to borrow, some time before the end of the present financial year, a further sum to meet the deficiency of £102,000 which it was estimated would be spent during that time. There were one or two pleasant features of the financial situation which he was glad to have the opportunity of placing before the Council. One had reference to gas profits, and the other to the electricity profits. There was standing to the credit of the Corporation on March 31 this year in accumulated gas profits, the sum of £45,305. He was asking the Council that day to vote in relief of the rates £10,500. They had already voted £5000 to be devoted to forming the nucleus of an insurance fund—making a total withdrawal from the gas profits of £15,500; and leaving a net unappropriated balance of £29,805. In regard to the electricity works, the profits were increasing very rapidly. After providing the handsome sum of £1986 for depreciation, the net profits on the undertaking for the year ended March 31, 1897, amounted to £4249. The profits for the past few years had steadily advanced. In 1892 they were £1385; in 1893, £1623; in 1894, £2138; in 1895, £1869; in 1896, £3297; and in 1897, £6225. Alderman F. Priestman asked if Mr. Ratcliffe could say what would be the maximum amount of water-rate in aid before the Corporation received income from the new water-works, and could information be accorded as to whether the town was within measurable distance of receiving water from the Nidd. Mr. Ratcliffe replied that some twelve months ago the Water Engineer furnished him with a statement as to the different sums of money required to be spent on the Nidd Valley scheme before it became revenue-producing; and the maximum amount of the rate in aid worked up to about 6d. in the pound. But this was on the assumption that the Corporation were still compelled to provide the £8000 per annum for sinking fund purposes during the whole time. If the relief the Corporation were seeking in this respect were granted by Parliament, it would modify the position by nearly 2d. in the pound. Alderman W. Holdsworth, the Chairman of the Water Committee, later in the proceedings stated that the water undertaking had not at present an income to cover all liabilities; but he thought he could say that in the future the Committee over which he presided would be as prosperous, and be able to render as much assistance to the funds of the town as the gas or any other Committee. There would be no water sent into Bradford from the Nidd Valley for at any rate three years, and it might be four; but the town would get water from a new source, though it would not be from the high reaches of the Nidd. The Nidd works were going on satisfactorily. In some places great difficulty was met in coping with the water; but on the whole, in this and other respects, it was not at all a dark picture that the Committee had to place before the Council.

PLYMOUTH AND STONEHOUSE GAS COMPANY.

The Annual General Meeting of this Company held on Thursday last—Mr. J. A. Bellamy (the Deputy-Chairman) presiding.

The Directors, in their report for the year ending the 31st of March, stated that there had been a satisfactory increase in the consumption of gas; the rental being £4896 in excess of last year. The Directors expressed regret that the prevailing low prices for residuals had prejudicially affected the income for the past year; but they hoped the efforts now being made to spread information respecting the value of sulphate of ammonia as a manure would have a beneficial result. After payment of the interim dividend in January, together with interest on the debenture stock, the balance remaining to the credit of the profit and loss account amounted to £21,252, from which the Directors recommended the payment of a dividend for the half year of 6½ per cent. on the ordinary stock, 9s. 9d. per share on the additional shares, and 9s. 3d. per share on the new shares. This would absorb £6790, and leave £14,462 to be carried to the credit of the next account. The Directors reported with deep regret the death of their colleague, Mr. Thomas Pitts, jun., and the retirement from the Board, in consequence of impaired health, of Mr. Robert Bayly. To meet the growing demand for gas, they had arranged for an extension of plant, and to meet the outlay proposed a further issue of capital by the sum of £10,000 of ordinary stock.

The Chairman, in moving the adoption of the report, referred with regret to the absence of Mr. G. Henderson, the Chairman of the Company, who was unwell, and was therefore unable to attend. The past year had, he said, been a fairly good one; the increase of £4896 in the rental being very satisfactory. The quantity of gas sold had increased by 59 million cubic feet; the number of new consumers by 296; and the number of new public lamps by 152. They had laid 2797 yards of new, and had renewed 1470 yards of old mains, put in 565 new service-pipes, and renewed 480 others. Since the last annual meeting, a new competitor had arrived in the shape of the electric light—at any rate, the plant was being laid down to supply it. The Directors were quite prepared to meet this competition. If there was one town in the country where gas could compete successfully with the electric light, that town was Plymouth. The advantages they had in cheap gas, the cheap freight for coals, the way in which their business had been worked in the past, and the position occupied by the Company, all justified him in saying that the competition of the electric light would be met without the slightest fear of the results as regards the shareholders' pockets. Recent improvements in the incandescent light made it probable that by the coming winter the Company would be able to make such a proposal to the Corporation that, extravagant as the latter might be in their desire to carry out electric lighting, they would not be able to ignore it. He doubted whether they would go to the extent of lighting the whole of the town with electricity. Leaving out the main thoroughfares which were already marked out for the light, the Company would be able to make proposals for the lighting of Plymouth with incandescent lamps, and make it practically the best-lighted town in the country at a cost representing a mere fraction of that of electricity. The incandescent burner was a means of enabling them to produce a light for private consumers and the public quite equal to electricity and at an infinitely less cost. If private consumers and the ratepayers could get a perfect light, as the incandescent burner, at a cost at which the Company were able to supply it, he credited them with sufficient sense to take that which was the cheapest. There was one disagreeable matter in the litigation which the Company had had, and which still continued, with one of their neighbours. The desire of the Directors had been to prevent a nuisance arising to anybody. They had called in the best technical advice they could get; they had spent large sums of money in carrying out improvements; and they held that the improvements they had made were of such a character that no nuisance now existed. They hoped that

this view would be held by the Official Referee when he resumed the inquiry.

Mr. J. Wills seconded the motion; and it was carried.

On the motion of the Chairman, seconded by Mr. Wills, the dividends as recommended were declared.

The retiring Directors (Messrs. R. J. Bazley, J. A. Bellamy, and J. Wills) and the Auditor (Mr. F. S Fowler) were re-elected.

It was then resolved that a resolution of sympathy should be sent to Mr. Henderson.

On the proposition of Mr. Hannaford, seconded by Mr. Snow, a vote of thanks was accorded the Directors for their unremitting attention to the business of the Company.

Mr. R. Woolland, in moving a vote of thanks to the officials, said he hoped the Directors would not meet the town lighting at the expense of the large consumers. The electric light was not going to do any serious damage; for the greater use of gas cooking-stoves would increase the demand for gas.

Mr. Snow seconded the resolution; and it was carried.

The Secretary (Mr. J. Thomas) acknowledged the compliment.

The meeting was then made special, and the issue of additional stock to the value of £10,000 was sanctioned. It was explained that the new water-gas plant was rendered necessary by the increased consumption of gas.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, 60, Gracechurch Street, E.C.—Mr. J. Birch Paddon in the chair.

The Secretary (Mr. A. W. Cooper) read the notice convening the meeting; and the Directors' report and accounts for the year ending March 31, referred to in the "Journal" for the 1st inst., were taken as read.

The Chairman, in moving the adoption of the report and accounts, said he did not expect to detain the shareholders long on this occasion; for this reason, that the incidents of the year had been the simple and direct outcome of facts with which they were all previously well acquainted. The chief event of the year had been the establishment in Malta by the Government of plant for the supply of the electric light; and it might be interesting if he briefly stated what had been done, and what was the effect of this installation upon their interests. At the meeting of the shareholders in 1892, he mentioned that proposals had been made to the Chief Secretary of Malta for the supply of the electric light, and that they had been favourably considered by him. He afterwards formulated a scheme for adopting the recommendations, and pressed it forward with all the persistency for which he is remarkable. It was very unpopular; but still he succeeded in getting a small—quite an accidental—majority, and his scheme was adopted. In 1894, a commencement was made with the erection of the works; and in December last, eleectricity was supplied to nearly all the public lamps and a gre at partofthe military establishments in Malta. The capital allcated for the purpose was £41,000; and of this £35,500 had been expended. The remain der would be required for an extension, in which the Company were not very closely concerned. The whole of this money had been taken from the public funds; and he (the Chairman) maintained that a more unwise and unnecessary expenditure had never been made. The Government had obtained nothing which they did not previously possess. They had simply exchanged one light for another which was not better, and was twice as dear. The consequence was their expenditure had already reached 50 per cent. more than it was when they had a supply of gas. He thought he might sum up the whole matter by saying that it was a thoroughly wasteful indulgence in a sentimental fallacy. As to the bearing of the electric lighting installation on the Company's interests an estimate based on the working of the first three months of this year showed that they would, in all probability, lose the sale of gas to the extent of 25 million cubic feet annually. But if they looked back to the time when the sale of gas was 25 millions less than now, it would be found that their capital at that time was rather larger than now, and that they then required more money to pay the same rates of dividend and interest than at present. Surely this was encouraging; but it was not all. Their conditions of manufacture were better now than then. At that time, they made gas at two stations —Valetta and Calcara—and at one of them gas was made very expensively. That station had been done away with; and all the gas was now produced at the other. The Company had still left to them the naval establishments, which they supplied under contract; and the supply to private consumers had been practically unaffected by the electric light. It was to this department of their undertaking that they had been in the habit of looking for an increase of business. The private consumption now was three times what it was ten years ago; and in the present accounts, it showed an increase of about 12·64 per cent. upon last year. With such rates of advancement, recoupment of their business was a certainty. Taking a comprehensive view of their affairs, the Directors had no misgivings whatever with regard to the future; and they saw no reason why the present rates of dividend should not be maintained. After all, they were simply passing through an experience common to all gas companies of importance, whether in England or elsewhere. The Directors had not quite finished with Corfu matters; the Municipality not having paid the money owing to the Company. But the Company had a judgment in their favour; and, if things were more settled in Greece, payment would be made—in fact, they were assured by their legal representative (who was an influential man locally) that the money would be paid. Of course, they had no alternative but to wait until affairs there were more settled. The shareholders would remember that, through the burden of exchange and the hostility of the Municipal Government, the profit of the Company had disappeared. In its place, they had now what he might call an assured income arising from the retirement of debentures, and the investment of the proceeds of the Corfu sale, amounting to about £870. At Sicily, things moved slowly. At Trapani they had a small increase; but at Marsala a small decrease. Therefore, they were practically where they were at the beginning of the year. At Marsala, the municipal authority got into arrear; and their attitude was so unsatisfactory that the Directors had to take legal proceedings in order to recover the money due. Judgment was given in favour of the Company upon all points; and the authority were directed to make payment when raising a loan. This, he did not think, would be difficult for them. But still they moved slowly in all they did; and some time might elapse before the Company obtained their money. Meantime, however, it carried interest at the rate of 6 per cent. The works throughout were in their usual good working condition. They had at Malta some surplus manufacturing power; so that they were not likely to require any extensions there. In regard to soundness, the mains were not all that could be desired. But efforts were being made for the purpose of reducing the unaccounted-for gas; and he trusted that they would be successful. As to the accounts, he thought they would be generally accepted as satisfactory. Capital was a diminishing quantity, in consequence of the paying off of debentures. On the 1st of next month, £4800 of debentures would mature, and would be paid off. The way in which the debenture debt was decreasing removed one of the obstacles to the plan of their late friend Mr. Dodgson, who wanted to establish one uniform 4 per cent. preference stock. Several other circumstances had occurred to make this scheme more practicable than it was; and there were some advantages which would arise from its adoption. All he could say at present was that it would not pass from the minds of the Directors. With regard to the revenue, a comparison with the accounts for last year was somewhat difficult on account of the elimination of the Corfu trading; but he might give some idea of the reductions which had been made in the several items. Coal was £1889 less; wages, £681 less; maintenance, £514 less; street lighting, £434 less; purification, £66 less; and rates and taxes, £20 more. General charges were £181 less. If they took the first group of revenue charges, they would find they were £3745 less than last year. The items which followed were all smaller; exchange (which was the principal one) being only one-tenth part of what it was in the previous accounts. The total decrease of these revenue charges was no less than £8128. Of course, there was a corresponding decrease in the receipts, but not to the same extent. The rental was less by £5869; and the residuals and fittings, by £1127. But then they had additional receipts amounting to £666; so that the total decrease in the income was £6430, against a decline in expenditure of £8128. It was this satisfactory difference that gave them their large profit of £11,238, against £9539 in the previous year. After the payment of interest and the dividend recommended, they would have a remainder of £1698. Of this sum, the Directors proposed to transfer £1500 to the invested reserve fund (not the reserve account); and this would leave a balance of £198 to be carried forward. The reserve account of £16,000 had been debited with some small charges in respect of the transfer of the Corfu property; and any further charges or loss that there might be in that connection would go to that account, and would not interfere with their general accounts hereafter. The invested reserve fund was becoming a very interesting factor. With the proposed addition it would amount to more than £4000; and this the Directors intended solely for the purpose of maintaining their present rates of dividend. In all probability, it would not be wanted; but it constituted a very substantial safeguard of the dividend.

Colonel J. Le Geyt Daniell seconded the motion.

Mr. F. H. Harvey inquired the amount of the debt due from Corfu.

The Chairman said it was composed of two parts—one from the private consumers, and the other from the Municipality. They had received the greater portion due from the private consumers; but there was £150 or £160 upon which he was afraid they could not reckon. The debt from the Municipality was a much more serious matter. If he recollected rightly, it was about £4200 in currency. This had to be discounted, as one-half or more would go in exchange. But he might say they had written off a large portion of it; so that nothing like the £4200 stood on their books.

The Secretary remarked that £2203 was the total amount standing in the books; the difference having been written off.

Mr. F. Lane Lingino spoke of the able manner in which the Company was managed, and of the satisfactory position which it occupied.

Mr. Harvey said he noticed that last year the amount invested in Consols was £8000; and this year it was only £1200. He asked whether the difference had been used in paying off the debentures.

The Chairman replied that it had exclusively.

The motion was unanimously carried.

On the proposition of the Chairman, seconded by Mr. Basil T. Makins, dividends were declared at the rate of 7 per cent. on the first preference shares, 7½ per cent. on the second preference shares, and 6 per cent. on the ordinary shares, less the payments already made.

The retiring Director (Mr. Stephenson R. Clarke) and the Auditors (Messrs. Hesketh Jones and T. Guyatt) were re-elected.

The Chairman, referring to the retirement from the Board, through illness, of Mr. J. Orwell Phillips, said he was a gentleman who was much sought after and appreciated by his colleagues; his standing in the gas world and his abilities making him a most desirable Director. The Board had cast about for some one to replace him who would be useful to the Company. They wanted a good worker; and they had found one in Mr. Basil Makins.

A cordial vote of thanks was passed to the Chairman and Directors and a similar compliment was paid to the officials and staff—the Chairman making particular mention of the untiring energy of the Secretary, the Manager (Mr. Starkey), and the Engineer (Mr. Solar).

Issue of Debenture Stock by the Gravesend Gas Company.—A recent issue of £3400 of debentures, bearing 3½ per cent. interest, by the Gravesend Gas Company, was applied for twice over. The average premium obtained was £1 4s. 3d. per cent.

The Proposed Purchase of the Budleigh Salterton Gas-Works.—The negotiations for the purchase of the Budleigh Salterton Gas-Works by the District Council have reached a rather advanced stage. At a meeting of the Council last Tuesday, a draft of the contract for the transfer of the works was submitted. The Council also had before them a letter from the Local Government Board, pointing out that, in order to raise the money for the purchase of the undertaking, the Council would have to proceed by way of a Provisional Order. Under these circumstances, the Council decided to take the opinion of the ratepayers on the subject; and before anything further is done, a meeting will be held to ascertain whether or not the ratepayers are in favour of the purchase.

DUNDEE CORPORATION GAS SUPPLY.

The Annual Gas Accounts—Reduction in the Price of Gas.

At a Meeting of the Town Council of Dundee, last Wednesday—Lord Provost M'Grady presiding—the accounts of the Gas Department for the year ending April 30 were submitted for consideration.

Treasurer Ritchie, in presenting the accounts, said it was estimated that the revenue would be £80,055 11s. 8d.; but the sum actually received had been £83,722 9s. 1d., an increase of £3666 17s. 5d. Of this increase, £2588 was due to the additional consumption of gas; and the balance chiefly to the gain on residual products. The increased consumption arose chiefly from two causes. The general prosperity of trade and commerce had undoubtedly contributed to this result; but another cause, not less influential, had been the policy adopted by the Council a year ago of abolishing meter-rents, and lowering the price of gas. There could be no doubt that the abolition of meter-rents met with the unqualified approval of the community; but it was also gratifying to find that the financial results of the policy were so satisfactory. He was persuaded that the lower the price of gas, the greater would, for a time at least, be its consumption; and he felt confident that every member of the Council rejoiced to hear of a growing consumption by the great body of the working classes, as such consumption meant to them more light, more warmth, and more comfort. The estimated expenditure for the year was £79,583 11s. 2d.; and the actual expenditure was £82,873 4s. 10d. This excess of actual over estimated expenditure, amounting to £3289 13s. 8d., was a source of gratification, as the additional outlay was almost wholly due to the extra amount of coal required to produce the greatly increased quantity of gas. The gas delivered during the year was 545,469,000 cubic feet, or fully 22,000,000 feet in excess of the estimate. These figures showed an increase in the gas consumption of 33,000,000 cubic feet over the previous year. The surplus amounted to £849 4s. 3d.; and the estimated surplus was £472 0s. 6d. Passing to the Electric Lighting Department, the estimated expenditure was £4493 14s. 4d.; and the actual £4860 11s. 9d.—an increase of £366 17s. 5d. The revenue anticipated was £5225; while that actually received was £5533 13s.—being £308 13s. increase. Turning to the estimates for the current year, the Gas Department revenue for next year, including the surplus income from the Electricity Department, was calculated to be £84,156 7s. 10d.; and the expenditure, £83,524 0s. 3d.—leaving a surplus of £632 7s. 7d. In regard to the Electricity Department, the expenditure was put at £5284 6s. 7d.; and the revenue, at £6000—exhibiting a surplus of £715 13s. 5d. He then proposed that the charge for gas should be reduced by 1d. per 1000 cubic feet—viz., from 3s. 3d. to 3s. 2d. Provision for this had been made in the accounts submitted. The reduction was rendered possible by the price at which they had been enabled to purchase coal, and from substantial reductions on other charges. Besides proposing this reduction in the price of gas, he had also to suggest a change in the mode of charging for electricity—basing it upon what was known as the Brighton system. He proposed that they should charge their usual rate of 5d. per unit until the consumer became profitable; and that when he had done so, the charge should be reduced from 5d. to 3½d. per unit.

The accounts were adopted; and the price of gas was fixed as recommended. But the Council, by a large majority, rejected the Treasurer's proposals with reference to the charge for electricity, and adopted a uniform rate of 4½d. per unit.

PERTH CORPORATION GAS SUPPLY.

The Annual Accounts.

At the Meeting of the Perth Gas Commission on Monday last week, Bailie Wright, the Convener of the Works Committee, submitted the accounts of the Commission for the past year. He said that their revenue from gas sold had been £19,551, as against £17,873 in the previous year; showing an increase of £1678. Coke had yielded £1202, being £97 under the estimate, and £84 less than last year. This was accounted for by having used a larger quantity at the works in getting the greater heats attained (the price having been only 6s. per ton during the whole year, against 9s. for a portion of the previous period), and also the fact that during the year they carbonized 5000 tons of English coal, which gave a larger amount of coke. The tar account showed the satisfactory increase of £642; the revenue having been £1126. A portion of this increase was credited to the fact that they had pumped the tar from the works to the tank-wagons of the contractor lying on the railway at Princes Street station. The pipe used was the one put in to convey the oil from the railway to the works. While meter-rents had been abolished, the rentals from cooking-stoves had filled up the blank. Their total revenue had been £22,593, as against £20,824 for the previous year. With such an augmented income, it was but natural that the expenditure should also show a considerable rise. When compared with the estimate, there had been an increase in ten items of expenditure, while in five there was a decrease. The increased expenditure had resulted in greater efficiency; and this, as he understood, was the truest economy. As shown in the accounts, their total debt on April 30 was £12,500. But to meet this there was a sinking fund, £1599; contingent fund, £2691; amount spent on gas-stoves, £1000—total, £5200; thus leaving a debt of only £7300. A feature of the year had been the enormous increase of consumers, chiefly as a result of the introduction of the prepayment meter. In 1895-6 the number of consumers was 6852; on April 30 this year there were 7362—an increase of 510 on the year. The gas consumed and paid for by prepayment meters was 2 million cubic feet. There had also been a substantial increase in the number of cookers on hire from the Commission; and to this department was mainly due the very great increase in the bulk of gas used during the year. While there was a decrease in the night consumption, the increase during the day had been 70 per cent. Three years ago, about 95 per cent. of the gas plant was standing idle during some weeks of the summer. In the present year, this had been reduced to 70 per cent. The Commission were now in possession of their Gas Act; and steps would be taken immediately to have the new works erected. For next year they estimated to have an expenditure of £22,331. To meet this they estimated to sell 123 million cubic feet of gas, at 3s. 2d. per 1000 cubic feet to Perth, and 3s. 7d. to Scone, which would return £19,055; while secondary products should be fully as remunerative as last year. With the balance brought forward, they would have a revenue of £22,500; leaving £169. By this reduction, the gas consumers of Perth would benefit to the extent of £2000, or a sum equal to fully 3d. in the pound on their taxes. In 1873, 1d. per 1000 cubic feet of gas represented on the total sale a sum of £146; in 1893, it had increased to £372; while for this year it would bring in £512. He concluded by formally moving that the accounts and estimate be adopted. This was agreed to, and the price of gas fixed at the figures given above.

ELECTRIC LIGHTING NOTES.

The Stockport Town Council have agreed to apply to the Local Government Board for sanction to borrow £25,000 for the purpose of establishing an electrical installation.

Plans and specifications have been prepared for the electric lighting works for Lincoln; and the Council have authorized the Committee to obtain tenders, and also given them discretionary power to execute part of the work.

The Brighton system of charging for electricity has been adopted at Derby. The price is to be 6d. per Board of Trade unit on a consumption of current equal to one-and-a-half hours' average of the maximum demand per day; and for all electricity used beyond this amount, the charge is to be at the rate of 3d. per unit.

Upon the recommendation of the Finance and Estate Committee, the Liverpool City Council have agreed to apply to the Local Government Board for their permission to the borrowing of a sum not exceeding £100,000 for extensions of the electric lighting undertaking, which have been already or may be hereafter authorized by the Council.

The Llandudno District Council have had before them a report by Mr. Preece on an electric lighting and refuse destructor scheme, the cost of which he estimates at £25,000. He urges promptitude of action if the scheme is to be ready for next season; and to facilitate this, the Council have invested the Electric Lighting Committee with power to act.

The Electric Lighting Department of the Wolverhampton Corporation has reached the rank of a paying concern. A report of the Lighting Committee shows that the operations of the past year have resulted in a net profit of £225, which has been applied to the deficiency on the working of previous years—reducing it to £1177. The total quantity of electricity generated was 287,507 units, of which 224,709 units were sold, and 60,820 units unaccounted for. The quantity used in lighting the streets was 73,466 units, for which £1242 was received, while the sale to private consumers realized £3779.

About a year ago, the Southampton Corporation acquired the property of the Electric Lighting Company; and soon after they entered upon a scheme of extension. One of the most important steps in this direction was the provision of a new electric lighting station; and the foundation-stone of the new building was laid last Tuesday week by the Mayor (Mr. E. Gayton) alongside the existing works. The ceremony was followed by a luncheon, at the conclusion of which the Mayor submitted, among other toasts, that of "Success to the Corporation Electric Supply." He stated that, not very long ago the Corporation could have purchased the Company's powers for £750; but a few months since, they paid £23,000 for the concern. He thought they had done rightly in purchasing it, because he believed, as time went on, it would be of the greatest benefit to the inhabitants of the town, and the profit would go in a large measure to reduce the rates. If their predecessors had been a little more progressive, the inhabitants would not have had such high rates as now—indeed, if the Corporation had (as they ought to have done) purchased the gas-works, they would not have had any rates at all to pay. This remark created some laughter; but his Worship held that it was true. In reply, Alderman Bone, the Chairman of the Electric Lighting Committee, gave an account of what had been accomplished financially during the year ending March last. He stated that the receipts had been £3491; and the working expenses (six months of which were paid to the Company) were only £2016. They had therefore a gross profit of £1475, which was sufficient to pay the interest and to repay capital to the amount of £508—leaving a balance of £42 in hand. He also mentioned that the contracts for rebuilding had reached £8000; and tenders had been invited for portions of new plant.

At a recent meeting of the Tunbridge Wells Town Council, Alderman Cronk drew attention to the electric lighting accounts, which he considered misleading. Mr. Wood said that it was clear to anyone who took the trouble to go into the matter that the accounts were for a complete year; but the previous few months' account had been added and the profit included the public lighting. The arc lighting cost £697, and they extinguished gas to the amount of £405; but each arc lamp gave nineteen times the amount of light yielded by a gas-lamp. Alderman Cronk said there was no doubt the public lighting was costing more now than it did under the old system. The whole town had at present to pay for the extraordinary lighting of certain thoroughfares. A letter was read from Sir D. Salomons as to the surplus produced by the Electric Light Department, and recommending that when this could be done, a sum equal to 5 per cent. on the capital outlay on the machinery, mains, &c., should be set aside to form a depreciation fund. He urged that half the present surplus should be placed to such a fund, to make a good start. The Town Clerk said they had no power, under their Act, to do as suggested; but their profit balance could be devoted to a reserve fund, to be invested and accumulated to the extent of one-tenth of the capital. There would, however, then be a difficulty as to what they could use the reserve for—whether for any deficit, or for any extraordinary demand or claim which did not include renewals. Mr. Wood said the Lighting Committee proposed to carry forward £800 after devoting £900 to the rates, and this could be used for the purpose suggested. Alderman Cronk said he had no desire to unfairly treat the matter of the accounts, but he thought it would be better in future to let them speak for themselves. In this instance, the electric light had the benefit of capital on which the interest was not paid by it until operations were commenced. The town lighting having, as they were told, increased, the Committee could, of course, make a profit by extending the electric light all over the place. The Electrical Engineer (Mr. H. L. P. Boot) said the public lighting was a loss, and formed a small proportion of the account. Alderman Cronk said if the public lighting was a loss they had better go back to the old

system. It was clear that the statement of profit was fallacious, and that the accounts were for months more than the year. Alderman Delves remarked that the Electrician had confirmed his own suspicions about the public lighting being a loss. Mr. Robinson said nothing could do away with the handsome profit shown; and, if so, it was surely desirable to light the town well, even if the public lighting did not yield a profit. Mr. Wood pointed out that the report did not say the profit was on the first year's working. Mr. Boot supported this; saying the statement was that the town was the first which had not made a call on the rates in the first year.

A recommendation by the Electric Lighting Committee of the Bath Corporation to apply to the Local Government Board for power to borrow a further sum of £3750, for the purpose of carrying out certain works recommended by Mr. R. Hammond, came before the Town Council last Tuesday, and gave rise to much discussion. The Chairman of the Committee (Alderman Sturges), in moving the adoption of the recommendation, explained that Mr. Hammond had stated that this sum would provide a first-class job, and obviate the necessity of spending any more money on the buildings for very many years. He (Alderman Sturges) admitted that the street lighting up to the present had not been a success, though the house lighting had been perfect; but there had been three electric standards put up as examples for street lighting, prettier and lower, while the light would be 2000 instead of 1200 candle power. The motion having been seconded, Alderman Ricketts expressed great surprise that nothing was known of these necessary works when the alterations and renovation of the buildings were carried out under contract a short time ago. Whose fault was it? He considered that the amount being spent by the Committee was far too large. They ought to have some inquiry into the matter; and he moved, as an amendment—"That a Special Committee be appointed to consider the position of the Electric Lighting Committee and their works, and to report before the expenditure of any more money was sanctioned." Mr. Peacock seconded the amendment, believing that some inquiry was necessary. Alderman Jolly said, whatever defects there might have been in the past, it was absolutely necessary that a further sum should be expended. What could a Special Committee do? He reminded the Council that they were not free in the beginning, as they had to take over the old works at an official valuation. Not only Mr. Hammond but Professor Kennedy thought the works when transferred to the Corporation were in a satisfactory condition. Mr. Silcock observed that on this occasion, as many times before, the Electric Lighting Committee wanted them to open their mouths and shut their eyes. The Committee were asking the Council for more than double the amount required for extensions in the first instance; and they had never presented a detailed report to show their reasons for it. After some further remarks, Alderman Chaffin, one of the Directors of the Bath Gas Company, rose to speak, when Alderman Sturges protested, remarking that neither Directors nor shareholders had any right to speak or vote on the question before the Council. The Mayor (Mr. G. Woodiwiss) said he thought they could speak; and he should be glad to hear the Alderman. Alderman Chaffin said his point was that the original scheme was for a limited lighting of the city. After this was accepted, the scheme, without the Committee being frank and candid to the Council, had been more than doubled. The result was that the expenditure had been more than doubled also. He was not going to say one word, being a Director of the Gas Company, against the course adopted; but he wished to point out that there had been a want of candour on the part of the Committee. Alderman Sturges, in reply, said the Electric Light Committee had had a new and very difficult work to perform. They had carried it out in the face of strong opposition; and, so far as they had gone, had succeeded very well. They had made mistakes; but to have a new Committee put over them he considered a gross insult. On being put, the amendment was lost by 19 votes to 4; several gentlemen interested in gas not voting. It was found, however, that in the minority was one shareholder, who said he had exercised his right as a ratepayer; and he was thereupon called on, amid laughter, to "plank down" his £50. His name was afterwards struck off the list of those who had voted.

The Profits of the Leeds Corporation Gas Department.—The Leeds Corporation Gas Committee had before them last Thursday the report for the financial year ending March 26. It showed a profit of £7133, after providing for sinking fund and interest. The profit for the previous year was £26,493; showing an apparent diminution of no less than £19,360. This large reduction does not, however, indicate decreased prosperity. During last year, the price of gas was 2s. 2d. per 1000 cubic feet; whereas for the first nine months of the preceding year, the rate was 2s. 4d. The value of residuals had also fallen. During the year ending March, 1896, the income from the sale of residuals was at the rate of 4s. 5d. per ton of coal carbonized; but last year it was only 3s. 10d.—a reduction of 7d. per ton. Had the price of gas and residuals been the same as in the previous year, there would have been a profit on the past year's working of £28,926, or an increase of £2433. The report, which was adopted, was regarded as satisfactory.

Increased Storage at the Keighley Gas-Works.—Last Tuesday, Colonel J. O. Hasted, R.E., one of the Inspectors of the Local Government Board, held an inquiry at Keighley into an application by the Keighley Town Council for power to raise money for street improvements and gas-works extensions. With regard to the latter, the sum of £10,639 was applied for in order that extra lifts might be put to two gasholders. The evidence in respect to this part of the application was given principally by the Gas Manager (Mr. J. Laycock). He said that in 1837 the production of gas was 3 million cubic feet; and this had grown to 267 millions now. The coal carbonized in the former year was 300 tons; and in the latter, 26,700 tons. At present the storage capacity was 1,446,000 cubic feet; this being only about a day's consumption. In one day last winter the consumption reached 2,100,000 cubic feet. By adding the two lifts, an increased storage of 940,000 cubic feet would be gained; bringing up the total to 2,386,000 cubic feet. It was intended to increase one holder this summer and the other next year; and the cost would be £5241 and £5398. The holders were constructed after borrowing powers had been obtained in 1874 and 1888; and therefore in each case the full sum raised had not yet been repaid. At the close of the proceedings, the Inspector was shown the gas-works.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held on Thursday last, at the Offices, Commercial Road, Pimlico—Sir W. H. Wyatt presiding.

The Secretary (Mr. G. H. Gill) read the notice calling the meeting, the minutes of the last half-yearly general meeting, and the report of the Company's Auditors.

The Governor, in moving the adoption of the report, said he had a pleasant task to discharge that day; for of all the accounts that had ever been submitted to them by the Directors, he thought that the present statement was perhaps the most satisfactory. Their income was steadily increasing. Their expenses were increasing also, though not in the same proportion as their income. The rates and taxes certainly pressed very heavily on them; but this was a matter over which they could exercise but little control. At Fulham, the district had been increasing very rapidly; and he did not know whether this was altogether a matter of satisfaction, because the houses were very small. The constant supply had been further extended in the Company's district; and 87 per cent. of the whole supply was now on this system. It involved a considerable quantity of water, particularly in connection with trades. They found that when people had water on the constant service, they used it for various purposes without giving the Company any notice. This, however, was a matter which they closely watched over; and when they considered it necessary, a customer was placed on the meter system. This was regarded by the latter as hard; but he (the speaker) did not see why it should be so considered. The new works authorized by their Act of 1896 were very nearly completed; and the construction of the filter-bed was going on well, though the contractors had been much obstructed by want of room. They had, however, carried out their work admirably; and one great advantage of employing such contractors as they engaged was this—that whether they found the work paid them or not, they carried out the contract to the letter. The capital authorized by their Act of 1896 was raised by public tender last February. The Governor of the Bank of England fixed the rate in the case of this Company at 2¾ per cent., which seemed very low. The rate in the case of all the other Companies was 3 per cent; but there was some reason for the difference. For instance, their own loan was to be raised all at once; whereas in the case of the other Companies, it was spread over two or three years. This made the matter a little more difficult than in the case of their Company. They obtained a slight premium; but, of course, they could not expect much with the interest at only 2¾ per cent. In regard to the Royal Commission which had been appointed, he feared that they would find it would be rather troublesome. He did not think they knew what they wanted; and it was difficult for the Directors to tell them. He did not know whether Counsel would be allowed to appear or not; and there was some doubt as to whether it would be desirable that Counsel should be employed. The majority of the Board thought it would be best to do so. The Directors were able to offer the proprietors, in addition to the half-yearly dividend of 5 per cent., an extra payment of ¼ per cent. for the half year (which was as good as ½ per cent. for the year) on account of previous dividends which had fallen short of the statutory yearly rate of 10 per cent. He thought this was very satisfactory; and it was the first time they had ever been able to make such a payment out of the half-year's income for the period ended at Lady-day.

The Deputy-Governor (Mr. F. S. Clayton) seconded the motion, which was unanimously adopted; resolutions were afterwards passed approving the dividends recommended, and re-electing the retiring Directors and Auditor.

A cordial vote of thanks to the Governor, Deputy-Governor, and the Directors terminated the proceedings.

SOUTHWAR AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at the Office, Southwark Bridge Road, on Tuesday last—Alderman Sir H. E. Knight in the chair.

The Secretary (Mr. Montague Watts) read the notice calling the meeting, and the report of the Directors was taken as read.

The Chairman regretted that there was so small an attendance of shareholders, though whenever this was the case it was a pretty sure indication that the affairs of the Company were in a prosperous condition. Though from the statement of accounts and the report they would be perfectly justified in arriving at this conclusion, yet he could assure them that the Directors were by no means lying on a bed of roses. They were surrounded by circumstances of such a character that they had to be continually on the watch; and it was a perpetual source of anxiety to them to take care of the property which had been entrusted to their charge. As regarded the capital account, he had very little to remark upon except that it was overdrawn by the sum of £11,000. This meant that they must very soon issue a further part of their "A" debenture stock. He simply referred to this so that they might be prepared for something of the kind within the next few months. In the capital account, there was an item of an increase during the past half year of £38,478; but this was really only a ledger figure. It would be remembered that they consolidated their debentures bearing 4½ and 4¼ per cent. into 4 per cent. debenture stock; and under the Act of Parliament, they had to give the debenture holders an extra amount of stock to place them in the position in which they stood previously. This was the explanation of the sum in question of £38,478. The revenue account was in every respect satisfactory, and bore evidence of the internal strength and the prosperity of their undertaking. In the maintenance, they would see that the total expenses in the past half year amounted to £48,022—showing a reduction on the corresponding period of the previous year of £5362, which would have been £7362, but that the rates and taxes had increased by £2000. He would not go into details with respect to the saving he had mentioned. There was no particular credit attached to the Directors for it. It was because in the corresponding period of last year they had heavy outlays to bear on account of the frost. The cost of management in the past half year was £8728, or £743 less, though they had had to pay £2458 for legal expenses,

against £1158 in the corresponding period of last year. The legal expenses had been very heavy for some time; but this was owing to causes beyond the control of the Directors. In these expenses this half year, they had included some portion of the costs connected with the Bill they promoted in Parliament last session, as well as the costs of the trial which they had last January with the Thames Conservators, with reference to the quantity of water they might take from the Thames. The expenses were watched very closely by them; and they never went to law if they could avoid it. In defending themselves from attacks, and in having to meet the great increase in the demands of their district, their law and parliamentary expenses had necessarily been very heavy. He hoped, however, that in the future they might be considerably less; and they would be so, if the Company were only let alone, and not attacked by those who wished to detract from the value of their undertaking in case there should be an opportunity to purchase it. To the other side of the revenue account, he called their attention with great pleasure. The water-rents accrued to the date of the account were £121,595, giving them an increase of £4903 compared with the corresponding period of last year. This was a figure that he had always had pleasure in referring to, because it showed the prosperity of their undertaking. An increase of £5000 in one half year, following on an increase, if his memory served him aright, of £6000 in the previous six months, showed that they had a very prosperous concern, and one which was open to great future development. With this increase, and with the amount saved in maintenance charges, they were £9714 to the good; and this was the difference between the amount carried this year to the dividend and interest account for transfer of profit (£62,068) and the amount carried to the same account a year ago (£52,345). Passing to the dividend and interest account, they had on the debtor side £21,891 to pay for interest on the debenture stock, compared with £20,391 a year previously—a difference of £1500, which was the amount of interest on the £100,000 of debenture stock they issued about twelve months previously. They were left with an amount available for dividend of £28,328. This sum showed that they had actually earned a 5½ per cent. dividend during the half year, though they recommended 5 per cent. He himself had been under the impression that they might have risked paying 5½ per cent.; but the matter was very closely gone into by the whole Board, who came to the conclusion that it would be safer, and more in the proprietors' interest, to be satisfied with 5 per cent. If they paid 5½ per cent., they would only have £39 to carry forward; and the Board felt that it was undesirable to have such a small balance, not knowing what contingencies might arise in the future. By paying 5 per cent. they would carry forward £2611; and this, they thought, would be again forming the nucleus of the fund which they ought to have in hand, but which was entirely taken away from them by the severe frost they experienced two years ago. They thought that the time had arrived when they should begin to build up a fresh reserve, so that in case of another calamity they might be able to pay an average dividend of 6 per cent., or certainly not less than 5 per cent. for the year. These were the feelings that had animated the Board; and there could not be a doubt that, on true financial principles, the Directors had come to a correct conclusion. He did not wish to prophesy; but he believed that next half year they would come out with a very respectable dividend, and a very good amount to carry forward to hold in hand for contingencies. He was very glad to be able to place accounts before them with so much confidence, and to point out the prosperous condition of the Company. With regard to the Directors' report, they referred to the Bills promoted by the London County Council this session, which were exactly the same as those promoted by this body in the previous year, and with which Parliament would have nothing to do. Nevertheless, the County Council brought them forward again this year. They must have felt that they could not get them passed; and they must have promoted them in order to put the Company to expense, and to prevent them from carrying out their business as well as they might do. These Bills the House of Commons refused to pass; and therefore the Company had been saved all the expense which they might otherwise have had to bear. A Royal Commission had been appointed to inquire into, and report on, the proposed purchase of the Water Companies; and they would report on other cognate questions besides. He thought that the Commission had been appointed to obtain information to enable Parliament to see the best course to be pursued in connection with the London Water Companies. The Commission had not yet commenced to sit. He need scarcely say that they and the other Water Companies would be very pleased to afford every information the Commission might ask for; but at the same time, they would not hesitate to meet any evidence that might be placed before the Commission by those who thought differently from themselves, and by those who thought that the Water Companies ought to be purchased, or managed, or done something with. In these matters, the Board would unceasingly watch over the interests of the proprietors; and they would put forward, if necessary, rebutting evidence on any question which might be raised adverse to them. They felt, however, that it was hardly possible to furnish evidence until they knew the reasons actuating those who thought it was best to take a course with respect to the London Water Companies, which the latter did not agree with. A Bill had been introduced by Mr. Chaplin to amend the law with respect to the Metropolitan Water Companies. This Bill was to enable any person who had a complaint to make his complaint before the Railway and Canal Commission. Why this Commission should be better than the Magistrates and the Courts to which people now had power to appeal, he did not know; but this was the Bill which had been brought in. The Bill appeared to him to be one that would subject the Water Companies to a good deal of expense, annoyance, and worry, without any benefit to the consumer, who already had power to appeal to authorities who had been found sufficient to protect him from any falling off on the part of the Water Companies in the performance of their duties. There was one very dangerous power taken in the Bill—that was, to give a local authority leave to aid a man making a complaint against a water company by paying any expenses he might incur. If, however, Parliament thought fit to pass the Bill, they must bow to it; and they would then have to do what they had done many times before—endeavour by every ability they possessed to protect the interests of the Company. The Bill approved by them at the Wharncliffe meeting had passed the second reading in the House of Commons; and it had been before a Committee of the House, who had passed the preamble of the Bill. They had yet to fight it further through Parliament, who, he had not the slightest doubt, would approve it. It was a very simple and reasonable Bill—one asking Parliament to let them do legally that which they were now doing illegally, according to Mr. Justice Mathews' decision. They did not propose to take more water from the Thames than they were now doing; but what they did take they wanted to take legally. Next year they were under contract to go to Parliament for a Bill by which the question would be settled permanently. He concluded by proposing the adoption of the report and accounts.

Mr. C. M. VIALLS seconded the motion.

Mr. JEFFRIES said he was a little disappointed that the Chairman and the Directors had thought fit to recommend a dividend of only 5 per cent., especially as during the past half year the number of supplies taken into charge had been 688, which produced an increased annual rental of £1648. He thought they ought to receive as much dividend as the Directors could pay them, after taking everything into consideration. He had expected that the Chairman would touch on the subject of leaky mains in the Company's district, on which there had been so many letters in the Press. He warmly referred to the services of the Secretary and staff.

The CHAIRMAN, in reply, said, as regarded the question of leaky mains, it was all nonsense. There had been one leaky main; but the whole matter had been greatly exaggerated. The main had been repaired. They had caused considerable damage to the road; but this had been made good according to the requirements of the Act of Parliament. The leakage was really next to nothing. As to the dividend, if it had not been for the iniquitous Act that was promoted by Mr. Torrens, the proprietors would have long ago received their 10 per cent. dividends and the back dividends that were due to them. They had had the Torrens Act, they had also had to meet the enormous expenses they had been put to by the County Council in defending the interests of the Company; and, furthermore, they had had to carry out very large and extensive works to meet the demands made upon them. These were all reasons which had helped to keep their dividends down. He believed they would now shortly be in a much better position for making progress.

The motion was carried unanimously.

The CHAIRMAN afterwards proposed the payment of the dividends recommended.

Mr. VIALLS seconded the motion.

Dr. CHESSHIRE said he felt that he must propose an amendment, to the effect that the dividend be at the rate of 5½ per cent.

Mr. JEFFRIES seconded the amendment.

The CHAIRMAN said he hoped that it would not be pressed. His opinion was that next half year the shareholders would have nothing to complain about with regard to the dividend.

The amendment was then withdrawn; and the original resolution was adopted.

On the motion of Mr. JEFFRIES, seconded by Dr. CHESSHIRE, a cordial vote of thanks was passed to the Chairman, Directors, and staff.

The proceedings then terminated.

Colne Corporation Gas Supply.—The profits of the Colne Corporation Gas Department for the past year amount to £2500; and this sum is to be transferred to the district fund.

Proposed New Scheme of Water Supply for Carlisle.—The Gas and Water Engineer of the Carlisle Corporation (Mr. C. B. Newton) has submitted to his Committee three schemes for the improvement of the water supply of the city—viz., a gravitation supply from the River Gelt; a new pumping scheme on the River Eden above Wetheral; and an extension and improvement of the existing works. Mr. Newton's report is to be printed and circulated among the members of the Council, after which they will discuss the question of submitting the schemes to an expert for his opinion. The Council have adopted a proposal of the Water Committee to extend the water-mains to Upperby.

Sandwich Gas Undertaking.—Major-Gen. H. D. Crozier, R.E., one of the Inspectors of the Local Government Board, recently held an inquiry at Sandwich in connection with the application of the Town Council to borrow £9000 for the purposes of the Sandwich Gas Order of 1896. The Town Clerk (Mr. T. Baker) said the population of the town at the last census was 2794; the assessable value, £10,897; and the amount of outstanding loans, £14,897—a considerable portion of this being for the purchase of the water-works; while the loans for general sanitary purposes were only in respect of £6148. The £9000 which it was now proposed to borrow worked out as follows: The Umpire's award for the purchase of the undertaking, £4600; law and parliamentary charges, £595; valuation of fixed plant, £74; new mains, £1062; new buildings, £426; gasholders, station meter, purifiers, &c., £1548; gas meters and cookers, £341; lenders' and borrowers' costs and contingencies, £352. The Inspector asked what the capital of the Company was. The Town Clerk said £4500. The Inspector observed that the amount to be paid for the purchase was £100 more than the capital. Referring to the other items, he said he could not understand coals, &c., being included under the heading of "fixed plant." He would call it plant, which would, of course, cover everything that way. He noticed it was proposed to use wood in the erection of a purifier-house. In the North of England, no one thought of using this material for such a purpose. It would be much better to use iron than a perishable material like wood; and he believed, too, that iron would cost less than wood. The ironwork could be easily obtained in London and shipped to Sandwich. When a Corporation went to work, they should do it permanently, and make it a credit to the town, as they could well afford to do with money at 3 per cent. There were no drawings of the proposed gasholder; and they could not expect the Local Government Board to sanction a loan in this respect unless they were in possession of full details. They had reckoned on the holder costing £900; and it might come to £1000. But they could not say, because they had not obtained an estimate from any makers, and knew nothing definite themselves. They had put down £50 for a photometer; but here again they had had no estimate, and it was very likely that it would cost more. However, he would make his report to the Local Government Board, who would in due course communicate their views to the Town Council.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Tay Valley is very much in evidence in my "Notes" this week. Both in Dundee and Perth, the annual accounts of the municipal gas undertakings were under consideration by the respective Corporations; and, in addition, there was at Perth on Wednesday the ceremony of inaugurating a new columnless gasholder, at which, on the kind invitation of the Gas Committee and Lord Provost Dewar, I had the pleasure of being present as your representative. There is also published Mr. Hepworth's report on the Broughty Ferry Corporation Gas-Works.

The Dundee Gas Department, it is pleasing to observe, is in a highly prosperous condition. The Committee a year ago estimated for an increase in the consumption of 11 million cubic feet; but this estimate was exactly doubled. The estimated surplus was £472; and it was actually £849, or nearly double. The great increase in the consumption of gas is attributed to the abolition of meter-rents and the greater demand for gas for heating and motive power. Thus it is manifest that an enlightened and liberal policy in the administration of gas undertakings is the way to success. It would be well if those who are directors or committee men in many of the smaller gas-works would take a look at what can be done by a generous policy, and be thereby induced to give up the hide-bound, unsympathetic course of treatment which they too frequently mete out to their customers. Gas at 6s. or 7s. per 1000 cubic feet cannot be expected to be a popular light, when the low price of oil is considered; and when the cheapness of carriage is taken into account, as well as the low rates at which coal is now obtained, there does not seem to be any occasion for such a high charge, unless it be because of antiquated plant in the retort-house. In small places, it is true, not much can be expected in the way of introducing labour-saving appliances; but something might be done towards the modernizing of the plant, so as to secure more gas from the coal. However, this remark has no reference to Dundee, where, it is well known to gas managers, the plant is all of the most modern description. But even in Dundee, it is evident that there is room for advance yet, in the matter of gas consumption. I confess it rather startled me to learn that there are as many as 9000 houses in the city in which gas is not used. This number surely could be greatly reduced. When I say this, I must also add that I am gratified to observe that the Gas Committee are taking steps to try to extend their business in this direction; and in this connection, the remarks of ex-Provost Ballingall, the Convener of the Committee, are worth giving. He said it was satisfactory that the experiment of granting relief from meter-rents had been successful; and now it was proposed to supply gas at a rate per 1000 cubic feet lower than had ever before been experienced in Dundee. In regard to the proposal for supplying gas on the penny-in-the-slot system, he had always thought they had a duty to the poor to perform. There were thousands of houses in Dundee in which there was no gas, and the people were obliged to burn paraffin. The Board had declined to trust the people who lived in these houses; and therefore until now they had had no opportunity of getting gas for the purposes of cooking or light. Now, however, the poorest individual would be able to get a pennyworth of gas at a time. It is almost characteristic of the Dundee Corporation that they declined to adopt the suggestion of the Committee to charge a differential rate for electricity. The members of the Corporation do not place implicit reliance upon their Committees, and have no hesitation in setting aside their recommendations. I have respect for their independence, because I know corporations in which it is considered to be unfriendly to interfere with any conclusion at which a committee may arrive, with the result that, if the small body comprising the committee can be persuaded, cozened, or squared, the object of the interested ones may be looked upon as secured. In Dundee, they seem to manage things better.

If the Dundee Corporation have done well in their gas administration in the past year, the Perth Gas Commission have, relatively, done better. An increase of 510 consumers is a matter upon which the Manager (Mr. A. Wilson) may pardonably feel a little pride. He has started with a good record in Perth. In the near future, he is to have upon his shoulders the important task of removing the gas-works to a new site, which may give him some anxiety; but when this is accomplished, he will have an opportunity such as few in Scotland have ever had. I had a look at the new site, and am satisfied that a more eligible one could not have been selected. It is about a mile to the south of the town proper, and lies between the railway and the Tay, from both of which deliveries of materials may be made. In this matter alone there will be a great saving to the Commission, compared with the present works, to and from which everything requires to be carted. Then the new site is at the lowest point of the area, which gives it an advantage over any other which could have been selected. The gasholder which was inaugurated this week, and which stands alongside another holder only a few years old, is situated on a site about midway between the new works and the town; and the governor-house has been built there. This is an unusual arrangement; but it has been adopted with deliberation, and there is every prospect of its working better and more economically than if the governors were inside the works. A man is stationed in the yard for other duties; and the governors will be under his charge. In these days, when the telephone is available, it does not much matter where the governor may be placed. Plans for the retort-house in the new works have been prepared; and at present specifications and schedules of the work in connection with them are being prepared. I perceive that in the working of last year, the yield of gas per ton of coal was 10,551 cubic feet, as compared with 9703 cubic feet in the preceding year. This is very gratifying to all concerned, as it must have been due to management, and not to the use of improved plant, that the increase was obtained. I daresay that the community will feel more interest in the large reduction in the price of gas which has been effected—from 3s. 6d. to 3s. 2d. per 1000 cubic feet; for, as was pointed out by Bailie Wright, the Convener of the Works Committee, it means a saving to consumers equal to 3d. per pound rental in the city. Such a handsome gift it is not often in the power of a corporation to give to a community. The Perth Gas Commission were not always distinguished for the enlightenment with

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which they managed their gas undertaking. I recollect, about ten years ago, how difficult they were to convince that it was positively necessary to make a large extension of the works. Mr. Whimster carried his point there, and the extension was made. The soundness of Mr. Whimster's scheme has been exemplified by the fact of the great expansion of business which has taken place since then, and by the other circumstance that the Commission have been able to reduce their debt to £5900. A new spirit seems to pervade the Commissioners, born, I suppose, of success in the past. Upon this both they and their officials deserve to be congratulated. Life to all is made more pleasant by the adoption of the progressive policy which the Commissioners now pursue; and the community are, in addition, greatly benefited by it.

The inauguration of the new gasholder at Perth was made more of than is usually the case when a holder of 650,000 cubic feet capacity is being brought into use. The interest, of course, was in the holder being of the new wire-rope guided type. It is the second of the kind in Scotland. Mr. Watson, of Falkirk, who has charge of the other one, was present; and he expresses himself as satisfied with the success of the method of construction. The after proceedings were of the most cordial nature, which was particularly pleasing in respect of the attitude of the Commissioners towards Mr. Whimster, their late Engineer and Manager. Mr. Whimster, despite his age, has the spirit of youth. The last time I heard him speak, he was buoyant over the success of his oil-gas installation; on this occasion he was complimentary with reference to the type of holder which had been erected. Mr. Whimster's friends will be pleased to learn that he is in the enjoyment of excellent health, and that he keeps his eye upon all that goes on in the gas world.

Mr. J. Hepworth, of Edinburgh, in his report to the Broughty Ferry Gas Commission on the condition of their works, has advised the Commissioners that, as between enrichment by cannel and by oil, the balance would probably be in favour of the oil-gas system. He recommends several changes in the oil-gas plant, for greater safety from fire; and he advises that suitable burners should be obtained for the consumption of it. He also recommends that the illuminating power should not be over 25 candles; otherwise there is risk of the flame smoking. He advocates the erection of a new gasholder, as the storage capacity at the works is defective. The holder could, he says, be built in two lifts—the inner lift, of 145,000 cubic feet capacity, at once, which would serve to meet the increasing demand for five years; and the outer lift, of 155,000 cubic feet capacity, when required. The storage requirements would thus be met for the next ten years. He is of opinion that the average pressure might be reduced to 2 inches. He considers that the position of the purifiers is not the most desirable; that the arrangement of the purifier-valves is antiquated; and that a duplication of the exhauster is absolutely necessary. He then proceeds to say that, unless for some reason which applied to this locality specially, it was not unreasonable to assume that the consumption of gas might be increased 100 per cent. within the next 15 or 16 years; and that the consumption of gas would be about 68 or 70 million cubic feet per annum by the end of this period. The present site was sufficient for any requisite extensions of plant to manufacture about 70 million cubic feet, provided that all additions to the plant from time to time were made with a view to the ultimate manufacture of this quantity. The present maximum daily make of gas at the works was 200,000 cubic feet; the annual make being 35,936,000 cubic feet. He assumed, therefore, that when the consumption of gas had been doubled, if this should ever happen, the maximum daily make would be about 400,000 cubic feet. The present daily capacity of the existing plant was as follows: Retorts, 320,000 cubic feet; condensers, 250,000; exhausters, 200,000; scrubber, 300,000; purifiers, 350,000; and station meter, 288,000. The three holders have a storage capacity of 160,000 cubic feet. To provide for the daily output of 400,000 cubic feet, it was desirable that the storage capacity should be in excess of this by about 25 per cent. The proposed holder would contain about 300,000 cubic feet; and with the present storage already mentioned, this would make the total capacity 460,000 cubic feet. If further storage should be afterwards required, it could be secured by telescoping the present east holder, increasing the amount to 530,000 cubic feet. It would thus be seen that, when the daily output of gas had reached about 450,000 cubic feet, the capacity of the plant and of the site would be practically exhausted. It was important that all future extensions should be carried out so as to utilize the present site to the fullest possible extent. The management and financial position of the works were, in his judgment, exceedingly satisfactory, as instances of which he mentioned: (1) That the annual capital charges, which in 1882 were 18·15d. per 1000 cubic feet of gas sold, had been reduced in 1896 to 8·90d.; (2) the price of gas, which was 5s. 10d. in 1882, was reduced to 2s. 11d. in 1896; and (3) the unaccounted-for gas, which in 1876 was 13·60 per cent., was reduced to 3·49 per cent.—probably the lowest in Scotland—in 1896. The condition and prosperity of the undertaking were in every way creditable to the Commission, and must be beneficial to the gas consumers and ratepayers. In conclusion, Mr. Hepworth urged an immediate application for additional borrowing powers to the extent of £15,000, so that there might be no delay in proceeding with the erection of the new holder in the early part of 1898. On Monday, the Commissioners resolved to circulate the report, so that they might consider the recommendations, and proceed at once with the duplication of the exhauster, as this matter is urgent.

On Monday morning, a fire broke out in the joiner's shop in the Greenock Corporation Gas-Works. The building was near the stores where tar and naphtha are kept; but fortunately the flames were prevented spreading to them. The damage amounted to about £150.

It is announced that the balance of profit on the working of the Dunfermline gas undertaking between May 31, 1896, when the Corporation acquired the works, and May 15 last, amounted to £1742; and that, but for some extraordinary expenditure, the amount would have been about £2500, after providing 3 per cent. on the purchase price. I expect a fuller account of the matter before next week.

The Glasgow Gas Commission have, it is announced, contracted for 400,000 to 500,000 tons of coal for the gas-works, for delivery in the year from August 1 next. The prices for splint, delivered at Dawsholm, are

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MERRIFIELD—WESTCOTT—PEARSON PATENTS.

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WINDSOR STREET WORKS, BIRMINGHAM	2,000,000
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SWINDON (NEW SWINDON GAS COMPANY)	125,000
WINDSOR STREET WORKS, BIRMINGHAM (Second Contract)	2,000,000
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N.B.—The M.-W.-P. Plant is built under penalty to Manufacture Gas on less Raw Material than any other Plant on the Market.

All Enquiries to be Addressed to the Company's Offices.

from 7s. 1d. to 7s. 3d. per ton; and delivered at Dalmarnock, 6s. 8d. to 6s. 11d. per ton. These figures are an advance on last year's rates of from 4d. to 6d. per ton. Besides splint, there are large quantities of first, second, and third class cannel, and whole-seam, the price for the latter of which is up from 2d. to 6d. per ton above that of last year. Some of the cannel has been procured at last year's rates, and part of it at a reduction.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 19.

Sulphate of Ammonia.—There has been a steady market throughout the week; and the closing quotations are £7 8s. 9d. to £7 10s. per ton f.o.b. Leith and Hull, and £7 12s. 6d. per ton f.o.b. Liverpool. The weakness in the Scotch market has disappeared; but buyers have declined to follow any advance. Export demand continues to be mainly from the west-coast ports; and consequently prices at these points remain relatively high. There is more disposition on the part of buyers abroad to operate in the forward position, if on about the level of prompt prices; but meantime they hesitate to pay the premium required by sellers. There has been speculative buying up to the end of the year.

Nitrate of Soda remains flat, at 7s. 4½d. per cwt. for ordinary, up to 7s. 6d. per cwt. for fine quality.

LONDON, *June* 19.

Tar Products.—Dulness still prevails in this market. There is a holiday character about it, which stops all serious business. Notwithstanding, benzols are quoted slightly dearer, while buyers of other products, excepting solvent naphtha, are woefully indifferent. Fortunately, distillers are partly free from stocks, and are easy in regard to market conditions. In one or two cases, speculative prices have been paid for tar; but they are quite exceptional. It is to be hoped these distillers will realize their sanguine anticipation of the near future.

The following are the average prices obtaining: Tar, 15s. 6d. to 18s. 6d. Pitch, 18s. to 21s. 6d. Benzol, 90's, 1s. 10d.; 50's, 2s. Toluol, 2s. 1d. Solvent naphtha, 1s. 6d. Crude, 30 per cent. naphtha, 11d. Creosote, 1½d.; liquid, 2½d. Heavy oils, 35s. Carbolic acid, 60's, 2s. Pressed naphthalene, 60s. Creosote salts, 25s. Anthracene, "A quality," 7d.; "B," 5d.

Sulphate of Ammonia is a little firmer; and buyers are operating more openly, and, in one or two cases, more directly. Considerable quantities have changed hands at prices ranging from £7 7s. 6d. to £7 12s. 6d., less 3½ per cent., according to port of shipment.

COAL TRADE REPORTS.

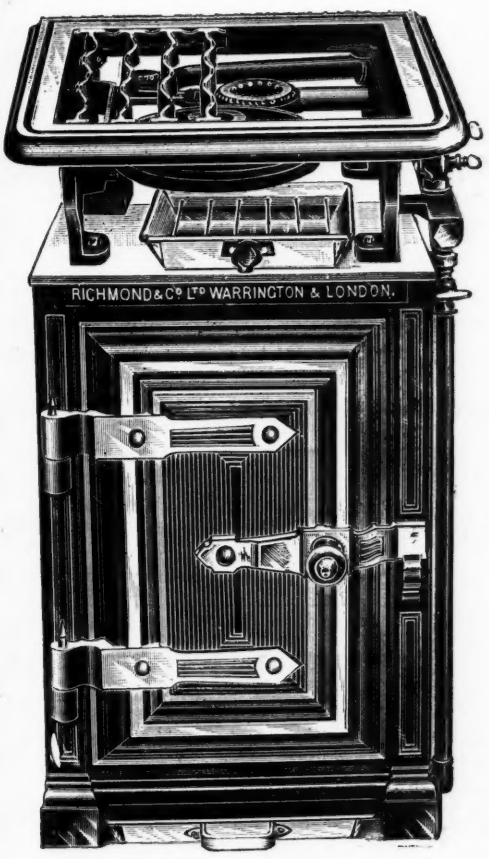
From Our Own Correspondents.

Lancashire Coal Trade.—Business is for the moment almost disorganized by the Jubilee Celebrations, following the Whitsuntide Holidays, and the other attractions in connection with the Royal Agricultural Society's Show in Manchester. For the better qualities of round coal the season of the year is necessarily restricting inquiries to the most limited dimensions; and although pits are working very irregularly, supplies are ample, with odd surplus lots of fuel in the market at low figures. Though list rates are not quotably altered, the tendency is to ease down where business is to be got. Common round coals are not quite as firm as last reported; shipping inquiries having fallen off somewhat. At the pit mouth, it is exceptional where more than 6s. to 6s. 3d. per ton is being obtained for good qualities of steam and forge coals; while for shipment, 7s. 9d. to 8s. 3d. per ton represent the average figures. With regard to gas coals, there is no material change to notice, except to confirm what has previously been reported—that no practical advance upon last season's prices has been secured upon contracts this year. Ordinary slack is still readily obtainable at 3s. 3d. to 3s. 6d. per ton at the pit; good medium sorts, 3s. 9d. to 4s. 3d.; with best slack quoted from 4s. 6d. up to 5s. The top figures, however, are only obtained in very special cases.

Northern Coal Trade.—The demand for coal has been much heavier the last few days. In anticipation of both local and general holidays, shipments have been pressed forward; and the collieries have had very full work. While this has been especially the case with steam coal, the gas coal collieries have been pressed much more than is usual at this season of the year. Best Northumbrian steam coals are very brisk, and command 8s. 6d. per ton f.o.b.; second-class steam are about 8s.; and steam smalls, 3s. 6d. to 3s. 9d. Manufacturing coals are very dull; and there is no change of moment in the prices. In the gas coal trade, there is increased firmness; and the consumption seems to be much above the usual—probably owing to Jubilee anticipations. The quotations for best Durham gas coals are very firm at 6s. 9d. to 7s. per ton f.o.b.; but in one or two cases a higher price is asked for single cargoes. No additional contracts of moment have been entered into of late. There is no alteration in the price of gas coke this week.

Scotch Coal Trade.—There is no change to record since last week. Ell is in demand; and prices remain firm. Splint shows no sign of improvement; and main is unchanged. The prices quoted are: Main, 6s. to 6s. 3d. f.o.b. Glasgow; ell, 6s. 6d. to 7s.; and splint, 6s. 6d. to 6s. 9d. The shipments for the week amounted to 158,771 tons—an increase of 11,417 tons over the preceding week, but a decrease of 802 tons on the corresponding week of last year. For the year to date, the total shipments have been 3,269,493 tons—an increase over the same period of last year of 119,712 tons.

The Matlock Water-Works Purchase Question.—The application of the Matlock District Council to the Directors of the Water Company for terms to purchase the undertaking was considered at an extraordinary meeting of the shareholders last Friday week. It was decided to give a non-committal reply, stating that the Company were not prepared to sell, and that, therefore, they could not fix a price. This leaves it open for the Council to make the first offer. The Company is an old-established concern, with a capital of close on £20,000, in £10 and £5 shares.



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Sales of Shares.—At the Mart, Tokenhouse Yard, last Wednesday, Messrs. Fox and Bousfield sold parts of Adventurers' shares in the New River at an average rate of £125,100 per share, and King's shares at an average rate of £118,600 per share; also some new shares, £100 paid, at £440 *ex div.*, and 3 per cent. terminable debenture stock at £118 and £119 per cent. *ex div.* The following shares have just changed hands: Twelve £10 shares in the Sheppey Gas Company (paying £10 per cent.), at £23 5s. per share. Five £20 "B" shares in the Colchester Gas Company, at an average of £35 per share. Four "A" shares (£27 paid) in the Maldon Gas Company, at an average of £48 10s. each; three £10 shares, at £10 15s. each; and 23 similar shares, at £11 12s. 6d. each. Some £5 (fully paid) shares in the Maldon Water Company, Limited, at an average of £5 15s. each. A parcel of 20 £5 shares in the Keymer and District Gas Company was sold by auction last Wednesday at £3 per share; and five £10 ordinary shares in the Maidstone Water Company secured £17 5s. per share. Some £10 shares in the Penzance Gas Company were sold last Tuesday at £11 10s. to £12 each.

Gas for "Jubilee" Illuminations.—Although there will be an enormous quantity of gas used for the illuminations in connection with the "Diamond Jubilee" celebration this week, no special effort has, we believe, been deemed necessary by the London Gas Companies to supply the exceptional demand upon them, as it will be compensated for to a large extent by the cessation of business, and the closing of shops where gas is largely employed for industrial purposes and motive power. It may be remembered that this was the case on the occasion of the Jubilee ten years ago. The Heywood Corporation Gas Committee have decided to supply gas for illumination purposes in connection with the Jubilee celebrations at 2d. per hour for 30 burners, and to lay the pipes and make the connections at cost price. The Gas Committee of the Rochdale Corporation have rescinded their resolution, referred to last week, to charge 1d. per hour for 20 jets, and have increased the number to 32. The present year is the Diamond Jubilee of the Lisburn Gas Company, and they will mark the coincidence of this event with the one over which the nation is rejoicing by supplying free of charge all gas used for illuminations to-night.

Walton-on-the-Naze in Darkness.—A brief paragraph in the "East Anglian Times" for the 9th inst. announced that Walton-on-the-Naze was in darkness on Bank Holiday owing to a stoppage in the supply of gas. A correspondent has sent us the following account of the affair as given to him by a local reporter: "On Monday evening [June 7], it was discovered that there was not a particle of gas in store at the gas-works. The town was full of visitors at the time, and all the hotels crowded; while a dramatic entertainment was announced at the Clifton Assembly Room. A visit to the gas-works disclosed the fact that the responsible proprietor and manager was out of town, and that his *locum tenens*, inexperienced in gas matters, was so overpowered by the fumes of the retort-house, that he was sound asleep. The retorts were cold, so that there was no hope of having any gas that night. Then there was a raid on dealers in lamps and paraffin oil, as well as chandlers' shops. Of course, the street-lamps were not lighted; and at the theatrical performance the footlights consisted of a row of candles placed in ginger-beer bottles. A collapse of this kind occurring on a Bank Holiday (and it is not the first time) caused great inconvenience and loss of business to the hotel proprietors and lodging-house keepers, while it placed visitors in a position of danger. Some enterprising Waltonians, who know their way about, started the fires at the works, and charged a retort; so that on Tuesday evening there was sufficient gas to supply the town."

Gas Cooking at the Recent Military Tournament.—The Royal Military Tournament which took place at the Agricultural Hall, Islington, from the 27th ult. to the 10th inst. calls for notice in our columns from the fact that by no means the least remarkable of the displays at that extraordinary show was that made by gas in the culinary department. On previous occasions, the catering for the soldiers has been done by a contractor; but this year the organizers of the Tournament decided to do it for themselves, under the supervision of Sergeant-Major Thompson, from the Military School of Cookery at Aldershot. It was necessary, in the first place, to provide a kitchen; and gas being the only practical means of cooking, Messrs. W. Sugg and Co., Limited, were entrusted with the work of supplying and fitting the requisite apparatus, which consisted of some 25 large appliances, including a roaster capable of cooking about 600 lbs. of meat, and a large gas-heated steamer, introduced and patented by Mr. Sugg, for cooking vegetables, puddings, &c., by dry steam at low pressure (not more than 2 lbs. per square inch). This latter apparatus cooks four sacks of potatoes at a time in twenty minutes, and 1800 eggs in four minutes. The entire cooking (breakfast, dinner, and tea) for 1000 men was done at a cost for gas of, as nearly as possible, ¼d. per head per day. We learn that the authorities saved upwards of £1000 by catering for themselves. They were delighted with the arrangements of the improvised kitchen; and the Commander-in-Chief himself expressed great satisfaction with them.

Messrs. W. Parkinson and Co. held a gas exhibition from Tuesday to Friday last week, in the Institute, Coleshill, Miss E. Sanderson giving practical demonstrations on cookery twice daily.

In conjunction with the Canterbury Gas and Water Company, the Cannon Hollow Ware Company last week held an exhibition of their gas-cookers and other appliances in the city. The cookery demonstrations were conducted by Miss Helen Edden.

The Pulsometer Engineering Company, Limited, are exhibiting a selection of their pulsometers, Deane and duplex pumps, filters, &c., at the Royal Agricultural Show, Manchester; and at their stand (No. 78) the pulsometer and torrent filter will be seen at work.

A very successful exhibition of gas appliances has lately been held at Formby by Mr. J. W. Buckley, the Manager of the Gas Company, and Messrs. Fletcher, Russell, and Co., Limited. Mrs. H. M. Young gave demonstrations on cookery twice daily to large audiences.

Messrs. E. Cockey and Sons, Limited, have received an order from the Great Western Railway Company for one of their improved dry-faced centre-valves, to work one, two, three, or four purifiers at a time. The Jersey Gaslight Company are constructing a new retort-house; and they have placed with Messrs. Cockey the order for the iron roof, 75 feet span and 164 feet long.

The Gas, Water, and General Investment Trust intimate that a provisional arrangement has been entered into for the consolidation of the Salt Lake and Ogden Gas and Electric Light Company, of Utah, with certain other electric light and power companies in the neighbourhood of Salt Lake City, and request holders of the issue of $1,500,000 six per cent. first mortgage gold bonds of the Company to lodge them with the July 1897 coupon attached, at the office of the Trust, in order that such amalgamation may be carried into effect.

The Gas Committee of the Manchester Corporation have accepted the tender of West's Gas Improvement Company, Limited, for the supply and erection of the cannel breaking, elevating, and conveying machinery, together with the coal-hoppers, measuring chambers, and structural ironwork, for the installation of 18 benches of inclined retorts which are being erected at their Gaythorn station, to the designs of Mr. G. Ernest Stevenson, M.Inst.C.E., the Consulting Gas Engineer to the Corporation. The Wellingborough Gas Company are extending their works; and, upon the recommendation of their Engineer (Mr. J. T. Lewis), they are adopting regenerator settings and stoking machinery. The whole of the work in connection with the new settings, including the ironwork and the stage flooring, has been placed in the hands of West's Company, who are also supplying their manual charging and drawing machinery with the requisite coal breaking and elevating plant.

The firm of Messrs. J. Defries and Sons, Limited, of Houndsditch, having been engaged in public illumination and decoration since the beginning of Her Majesty's reign, it seems only natural that they should have secured, as they have, a large share of the work now being done to brighten up our leading thoroughfares, and the more important buildings abutting thereon, in view of the great event which takes place to-day Messrs. Defries have, on the present occasion, not only striven themselves to raise the standard of design employed in illumination devices, but they secured the aid of Professor Legros to provide a decoration for their largest work—that at the Bank of England. The study for the *façade* of this building was on view, together with a large number of excellent designs prepared by Messrs. Defries—one being for the gateway of Marlborough House—in the East Hall of the Imperial Institute last Wednesday; and it gave promise of being highly effective in realization. The introduction, for the first time in this country, of an artist of first-class importance into public decoration, marks an epoch in the art, and deserves to be recorded as evidence of the firm's enterprise.

NOTICE TO ADVERTISERS.—**COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.**

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

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[For Illustrated Advertisement, see p. 1454.]

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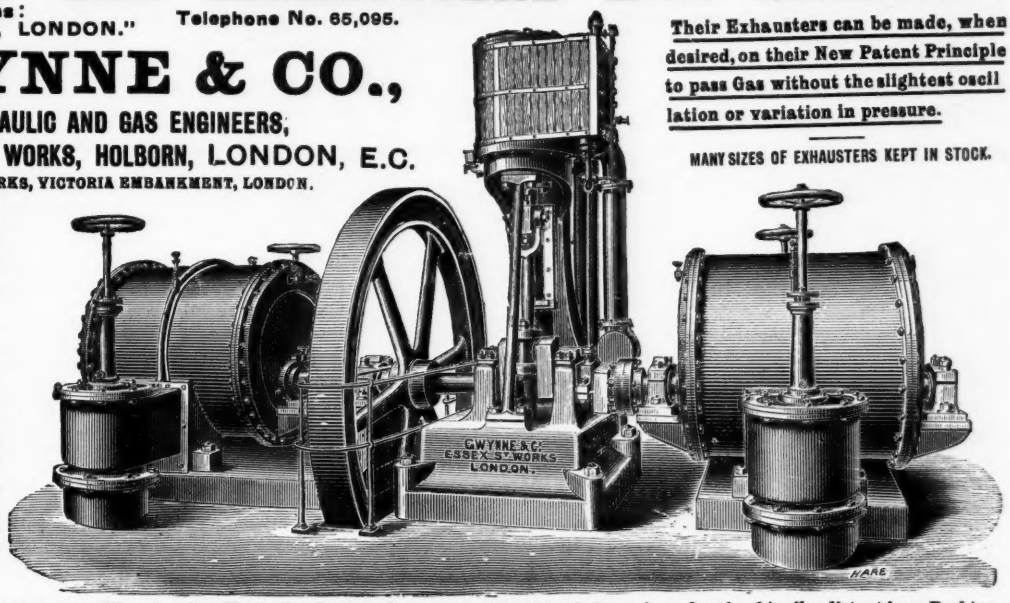

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Address No. 2864, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GREAT YARMOUTH GAS COMPANY.

WANTED, a Foreman to take charge of Works at night. One with mechanical knowledge will be preferred. Wages £2 per week.
Apply, stating Age, Experience, and all Particulars, to ENGINEER, Gas Company, GREAT YARMOUTH.

WANTED, at a Provincial Gas-Works, a RETORT-HOUSE FOREMAN. Must be under 40. One having knowledge of Carburetted Water-Gas Manufacture preferred. *Copies* of Characters only to be forwarded. Wages £2 per week.
Apply, by letter, to No. 2866, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Mantleless Incandescent Gas Corporation, Limited, are about to appoint AGENTS throughout the United Kingdom for the SALE of their PATENT BURNERS, and are now prepared to receive APPLICATIONS from Gas Engineers, Ironmongers, Gas-Fitters, Plumbers, Builders, Decorators, &c.
Apply, by letter, in the first instance, to THOMAS FLOYD AND CO., 20, Victoria Street, LONDON, S.W.

SADLER & Co., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.
Correspondence invited.
Telegraphic Address: "Sadler, Middlesbrough."

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS.
MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1759.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS,
Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

ALEX. P. KER, C.E., Consulting Gas Engineer, Hunton Road, Gravelly Hill, Birmingham, 25 Years Assistant Engineer and Manager of Works to the Corporation of Birmingham and their predecessors, MAY BE CONSULTED on all matters connected with GAS ENGINEERING, including Valuations, Alterations, Additions and Extensions, &c. REPORTS upon EXISTING WORKS and IN PROGRESS. EXAMINATIONS OF GAS for ILLUMINATING POWER and IMPURITIES conducted. Plans, Specifications, and Estimates prepared.

WANTED, Retort Setters and Bricklayers.
Apply to R. DEMPSTER AND SONS, LIMITED, Elland, YORKS.

GAS CARBON Wanted, not less than 4-Ton Loads.
Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

WANTED, to purchase Gas Carbon delivered at nearest Station to Gas-Works, in quantities of not less than 4 tons.
Address, stating Price per ton and quantity, No. 2772, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, to purchase, a set of four PURIFIERS, about 9 feet square by 4 feet deep. Must be in good condition, with necessary Lifting Apparatus, Valves, &c., complete.
Apply to W. A. CLARKE, Selborne Buildings, Millstone Lane, LEICESTER.

FOR SALE—A Station Meter complete, in thorough working order. Recently overhauled and certified correct by Messrs. Braddock. Capacity, 50,000 feet per hour.
Apply to JOHN H. DARBY, Brymbo, near WREXHAM.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also COMPLETE WORKS equal to 7000, 20,000, 60,000 cubic feet per diem. **Inquire and compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

BLUE PRINTS of all kinds in any weather. Drawings and Tracings promptly executed.
J. L. FEATHERSTONE, 21, Old Queen Street, WESTMINSTER, S.W.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH,
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

TO GAS AND WATER OFFICIALS.

SPECIAL and Favourable Terms for CYCLES are offered. The very best "up-to-date" Cycle at a reasonable Cost. "Dunlop" Tyres, Weldless Tube throughout, "Westwood" Rims, "Brook's" Saddle, "Perry's" or "Renold's" Chain, &c. The whole combining to make as fine a Machine as is possible to be made. Satisfaction guaranteed. Send at once for Catalogue post free.
MELROSE CYCLE COMPANY, COVENTRY.

ECONOMY IN PURIFICATION.

INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.
References and Particulars can be obtained from the Makers—
C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.
And J. EVERY & SON, Phœnix Iron-Works, LEWES.

STORAGE Tanks for Tar and Liquor.
Several Wrought and Cast Iron ones up to 275,000 gallons capacity FOR DISPOSAL, cheap.
J. FIRTH BLAKELEY, Gas Engineers, Ravensthorpe, YORKS.

FOR SALE—A Station Meter of 10,000 cubic feet capacity, by Parkinson, of London. Only used a short time, and is in excellent condition.
For further Particulars, apply to No. 2865, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

PREPAYMENT METER.

THE Inventor of a simple and effective PREPAYMENT MECHANISM is open TO OFFERS.
Address "COIN-FREED," care of W. H. Harvey, 17, Old Queen Street, Westminster, LONDON, S.W.

FOR SALE, cheap—
One TELESCOPIC GASHOLDER, 32 ft. diameter, with two lifts 14 ft. deep each; Capacity, 22,500 cubic feet, with Wrought-Iron Tank complete.
One CAST-IRON SCRUBBER, 38 ft. 6 in. by 6 ft. diameter.
Four PURIFIERS, 12 feet square by 4 feet deep with 12-inch Valves and Connections complete.
Two PURIFIERS, 8 feet square, complete, with 6-inch Bye-Pass Valves and Connections.
EXHAUSTERS, 5000 to 60,000 cubic feet per hour.
We would undertake to re-erect any of the above, if desired.
Photos, Particulars, and Prices of above on application to SAML. WHILE AND SONS, 60, Queen Victoria Street, LONDON, E.C.

FOR SALE—350 to 400 Tons of Pitch.
Good, Medium, Soft Quality. Made from English Coal Tar Distillation.
Apply Messrs. R. W. GOOLD AND CO., 32, English Street, CARLISLE.

FOR Sale, or Manufacturing on Royalty, my PATENT for England (eventually for other Countries) in respect of a PREPAYING APPARATUS, suitable for dry as well as for Wet Gas-Meters. The Claims are: (1) Simplicity and Compactness of Mechanism. (2) Absolute Accuracy. (3) Suitability for all sorts of Coins. (4) Changing of the Gas Price can be made very Quickly, Easily, Accurately, and in a controllable manner.
Advertiser is going to England, Belgium, and Germany on the 1st of July, and will take his Models with him to show them to intending Buyers.
For further Particulars, apply, before the 2nd of July, to L. P. V. MADSEN, Managing Clerk at the Meter Department of the Municipal Gas-Works in Copenhagen, 16, Martenstensallé, Copenhagen, V. DENMARK.

COMPLETE GAS PLANT FOR SALE.

TO BE SOLD separately, or in one lot—
Two Double-Lift HOLDERS, 34 ft. 4 in. diameter outer, 33 ft. 10 in. inner, 14 ft. 3 in. deep, with Pipes, &c.
One GOVERNOR, SYPHON-BOXES, VALVES, &c.
One STATION METER, with Valves (new), Braddock's make.
One Set of four PURIFIERS, 7 ft. square by 4 ft. deep, Walker's make, with Grids and one of their Centre-Valves, Connections, and Lifting Gear.
One TAR-PUMP and STORE BOILER.
One "ECLIPSE" WASHER-SCRUBBER, Laycock and Clapham, with Pulleys and Governor, erected in 1890.
One EXHAUSTER, with 12-inch Valves and Connections.
One Horizontal CONDENSER, with fourteen 8-inch Pipes, 18 ft. long, with Bye-Pass, Valves, and Connections.
Twenty RETORT MOUTHPIECES, with Lids and Duplicates, Dip, Ascension, and Bridge Pipes, Hydraulic Main and Valve, Fire-Doors, Buckstaves, and Tie-Rods.
12-inch and 8-inch MAINS, at per ton.
12-inch VALVES, at each.
For further Particulars and Prices, apply to H. I. WILLIAMS AND CO., Kidsgrove, STOKE-ON-TRENT.

BROSELEY GAS & COKE COMPANY, LIMITED.

THE Directors of the above Company invite TENDERS for about 500 Tons of best screened GAS COAL, delivered to Ironbridge Station, over Twelve Months from the 1st of August next.
Tenders to be sent in by the 1st prox.
JOHN POUNTNEY,
Secretary.
Broseley.

EAST RETFORD CORPORATION GAS UNDERTAKING.

THE Gas Committee of the above are open to receive TENDERS for the supply of 5000 Tons of best screened GAS COAL or NUTS, delivered free at the Sidings of the G.N. or M.S. & L. Railway Stations as may be required during the Year ending June 30, 1898.
Tenders to be sent in, addressed to the Chairman of the Gas Committee, on or before the 30th inst., endorsed "Tender for Coal."
Any further Particulars may be had from the undersigned.
The lowest or any tender will not necessarily be accepted.
J. B. FENWICK,
Engineer and Manager.
Gas and Water Office, Retford,
June 9 1897.

EAST RETFORD CORPORATION GAS UNDERTAKING.

TO MANUFACTURING CHEMISTS, &c.

THE Gas Committee of the above are open to receive OFFERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the Year ending June 30, 1898.
Tenders, stating price per ton, with scale of Prices for Liquor according to strength as tested by Twaddel's Hydrometer at our Works, to be sent in on or before June 30, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Tar" or "Liquor."
Any further Particulars may be had from the undersigned.
The highest or any tender will not necessarily be accepted.
J. B. FENWICK,
Engineer and Manager.
Gas and Water Office, Retford,
June 9, 1897.

EAST RETFORD CORPORATION WATER UNDERTAKING.

TO ENGINEERS AND ROOF MANUFACTURERS.

THE Water Committee of the above Corporation invite TENDERS for the supply and erection of a CORRUGATED IRON ROOF, with Supports, Framing, Guttering, and Railing complete over their Water-Works Tower Tank.
Plans and Specification may be seen, and further Information obtained, on application to the undersigned.
Tenders to be sent in, addressed to the Chairman of the Water Committee, and endorsed "Tender for Roof," on or before the 30th inst.
The lowest or any tender will not necessarily be accepted.
J. B. FENWICK,
Engineer and Manager.
Gas and Water Offices, Retford,
June 9, 1897.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for about 10,000 Tons of GAS COAL and CANNEL.
Particulars may be obtained from the undersigned, to whom Tenders, properly endorsed, must be delivered on or before Friday, the 2nd of July.
JAMES BRADDOCK,
Manager and Secretary.
Gas Offices, Radcliffe,
June 16, 1897.

OLDHAM CORPORATION WATER-WORKS.

ROODEN RESERVOIR—IRONWORK, VALVES, &c.

THE Water-Works Committee are pre- pared to receive TENDERS for the supply of IRONWORK, VALVES, &c., required in the construction of this Reservoir.
The Specification and Forms of Tender may be obtained and Drawings may be seen at the Offices of Messrs. G. H. Hill and Sons, 3, Victoria Street, Westminster, and Albert Chambers, Albert Square, Manchester, on payment of one guinea.
Sealed tenders, endorsed "Tender for Ironwork, Valves, &c.," must be addressed to Mr. Arthur Andrew, Water-Works Offices, Oldham, on or before Tuesday, July 13, 1897.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
A. NICHOLSON,
Town Clerk.
Town Hall, Oldham,
June 16, 1897.

TYLDESLEY URBAN DISTRICT COUNCIL.
(GAS AND WATER DEPARTMENT.)

THE Committee are desirous of receiving TENDERS for supplying and fixing one 15,000 cubic feet per hour HORIZONTAL ENGINE and ROTARY EXHAUSTER combined on one Bed-Plate.
Full Specification to accompany the tender.
Any further Information may be obtained on application to the Engineer, Mr. J. Timmins, Netherleigh, The Park, Wigan.
Tenders, endorsed "Exhauster," must be delivered to me on or before the 28th inst.
The Committee do not bind themselves to accept the lowest or any tender.
FRANK T. WRIGHT,
Clerk to the Council.
Council Offices, Tyldesley,
June 7, 1897.

TIPTON GAS-WORKS.

COAL CONTRACTS.

THE Gas Committee of the Tipton Urban District Council are prepared to receive TENDERS for the supply of GAS COAL for a period of One, Two, or Three Years, from the 1st of July next, to be delivered, Carriage free, to the Gas-Works Siding (L. & N.W. Railway).
Specifications and Form of Tender may be obtained at the Gas-Works, on application to Mr. Vincent Hughes, the Engineer and Manager.
Sealed and endorsed tenders to be sent to me the undersigned, not later than Ten a.m., on Saturday, the 26th inst.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
GEO. M. WARING,
Clerk to the Council.
Public Offices, Tipton,
June 5, 1897.

LINCOLN CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Cor- poration invite TENDERS for the supply of 25,000 Tons of screened GAS COAL and NUTS, to be delivered during a period commencing the 1st of July, 1897, and terminating the 30th of June, 1898.
Further Particulars and Forms of Tender may be obtained from the undersigned.
Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 26th inst.
The Committee do not bind themselves to accept the lowest or any tender.
JNO. CARTER,
Manager.
Gas Offices, Lincoln,
June 5, 1897.

CITY OF LEEDS.
(GAS DEPARTMENT.)

TENDERS FOR COAL AND CANNEL.

THE Gas Committee of the Leeds City Council are prepared to receive TENDERS for the supply of about 40,000 Tons of CANNEL, and about 180,000 Tons of best GAS COAL (Screened or Nuts). Price per ton to be quoted delivered at the Meadow Lane Gas-Works (Hunslet Lane Siding), New Wortley (Gelderd Junction Siding), or at the Gas-Works, York Street, in such quantities as may be required.
Forms of Tender may be obtained on application to the undersigned.
Tenders may be for any portion of the total quantity required, and will be received not later than Monday, the 28th inst., addressed to the Chairman of the Gas Committee, Municipal Buildings, Calverley Street, and endorsed "Tender for Coal."
The Committee do not bind themselves to accept the lowest or any tender.
R. H. TOWNSLEY,
General Manager.
Municipal Offices, Calverley Street,
Leeds, June 12, 1897.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Seaford Gas Com- pany invite TENDERS for about 700 Tons of GAS COAL and 60 Tons of CANNEL, delivered free, within Twelve Months, at Seaford Station, L.B. & S.C. Railway, in quantities of ten Truck Loads, as required.
No Forms.
Tenders to be addressed to the SECRETARY, Gas Company, Seaford, SUSSEX.

THE Gas Committee of the Keighley Corporation are prepared to receive TENDERS for the supply of 270 Tons of SULPHURIC ACID during the next Twelve Months.
Particulars and Form of Tender may be obtained on application to the undersigned.
Tenders, addressed to the Chairman of the Gas Committee, to be sent in not later than Monday, the 28th inst.
By order,
JOHN LAYCOCK,
Engineer.
Gas Offices, Keighley.

TAR.

THE Directors of the Reading Gas Com- pany invite TENDERS for the purchase of their surplus TAR for One Year, commencing on the 1st of July next.
Specifications for the contract will be forwarded on application.
Rail communication direct to the Works.
Tenders, endorsed "Tender for Tar," must be delivered not later than Monday, the 28th of June, to
ARTHUR H. CANE,
Secretary.
7, King Street, Reading,
June 10, 1897.

WORTHING GAS COMPANY.

TAR AND LIQUOR CONTRACT.

THE Directors of the above Company invite TENDERS for the surplus TAR and AMMONIACAL LIQUOR manufactured on the Company's Works, for One Year, from the 1st of July next.
Tenders to state Price, free on Rail Worthing Station, at per gallon for Tar, and at per 1000 Gallons for Liquor, of a minimum Strength of 10 oz.
Tenders, addressed to W. F. Verrall, Esq., Secretary, and endorsed "Tar and Liquor," to be sent on or before Thursday, July 1, 1897.
W. A. WALKER,
Manager.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)

COAL AND CANNEL.

THE Gas Committee of the above Borough invite TENDERS for the supply of COAL and CANNEL.
Further Particulars and Forms of Tender may be obtained on application to Mr. W. S. Haddock, Engineer to the Works.
Tenders must be sent in not later than the 30th inst.
FREDK. TAYLOR,
Secretary.
Gas Offices, Warrington,
June 12, 1897.

DISTRICT OF NEWTON-IN-MAKERFIELD.

THE Gas Committee of the above Council invite TENDERS for the supply and erection of four PURIFIERS, each 20 feet square, with Centre-Valve and Connections according to the terms of a Specification, which may be seen on application at my Office, where Tenders with Drawings of same may be delivered, endorsed "Purifiers," not later than Saturday, the 3rd of July next.
The lowest tender will not necessarily be accepted.
RICH. BRIERLEY,
Engineer and Surveyor.
Town Hall, Earlestown,
June 18, 1897.

BOROUGH OF NOTTINGHAM.
(WATER DEPARTMENT.)

TENDERS FOR THE SUPPLY OF VALVES AND HYDRANTS, PIPES, LEAD, COAL, TAPS, AND FITTINGS.

THE Water Committee of the Corpora- tion are prepared to receive TENDERS from competent Ironfounders, Brassfounders, Valve Manufacturers, Lead Merchants, and Colliery Proprietors and Coal Merchants, for the supply of the undermentioned Goods for the ensuing Year:—
1. CAST-IRON DOUBLE-FACED SLUICE VALVES and HYDRANTS.
2. CAST-IRON MAIN PIPES.
CAST-IRON SPECIAL PIPES.
3. LEAD PIPING.
LEAD INGOTS.
4. GUN-METAL TAPS and FERRULE FITTINGS.
5. STEAM COAL and OTHER FUEL.
Specifications and Drawings, together with Samples, Weights, &c., may be seen, and other Information obtained, at the Office of the Water Manager, Mr. Stephen Moore, St. Peter's Church-Side; and Forms of Tender may be obtained at that Office on payment of One Guinea, which sum will be returned on receipt of a *bonâ-fide* tender.
Tenders, endorsed "Tender for Valves," "Tender for Pipes," "Tender for Lead," "Tender for Taps," or "Tender for Coal," to be delivered to me at the Guildhall, Nottingham, on or before the 3rd day of July next.
The Committee do not bind themselves to accept the lowest or any tender.
By order of the Water Committee,
SAMUEL G. JOHNSON,
Town Clerk.
Guildhall, Nottingham,
June 18, 1897.

CORPORATION OF COLNE.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the surplus TAR made at the Gas-Works during the Year ending March 25, 1898.
Estimated quantity, 650 Tons.
Tenders, endorsed "Tender for Tar," to be delivered at the Office of the undersigned, on or before Saturday, the 26th day of June, 1897.
HY. SIMMONDS, C.E.,
Engineer and Manager.
Gas-Works Offices,
Knotts Lane, Colne, Lancs.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company so far as they relate to the DEBENTURE STOCK WILL BE CLOSED at Ten o'clock forenoon on Friday, the 18th inst., and RE-OPENED on Friday, the 25th inst.
The Interest for the Half Year to the 30th of June, 1897, will be payable on the 1st day of July next to the Proprietors registered on the closing of the Books.
By order,
JAMES RANDALL,
Secretary.
Offices: Willoughby Lane,
Tottenham, June 18, 1897.

NEWCASTLE-ON-TYNE AND GATESHEAD GAS COMPANY.

SALE OF FIVE PER CENT. PREFERENCE STOCK.

THE Directors have instructed Mr. ROBERT MACK, Auctioneer, to SELL BY AUCTION, at the Offices of the Company, Grainger Street West, Newcastle-upon-Tyne, on Wednesday, the 30th day of June, 1897, at Twelve o'clock noon precisely, £20,000 of the NEWCASTLE-UPON-TYNE AND GATESHEAD GAS PREFERENCE STOCK, bearing a fixed Preferential Dividend of 5 per cent. per annum, being part of the moneys authorized to be raised by the Newcastle-upon-Tyne and Gateshead Gas Act, 1896.
For Conditions of Sale and further Particulars, apply to the undersigned.
THOS. WADDOM,
Secretary.
Gas Office, Newcastle-upon-Tyne,
June 3, 1897.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Power.
He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.
Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.
Offices: 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the
TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

SALE OF DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Monday, July 5, at Two o'clock, in lots, £15,000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK of the above Undertaking, offering to Trustees and others an Investment of the soundest character.
Particulars at the COMPANY'S OFFICES, TOTTENHAM; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C., and TOTTENHAM.

By Order of the Directors.
GUILDFORD GASLIGHT AND COKE COMPANY.

SALE OF £5000 STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Tuesday, July 6, at Two o'clock, in Lots, £5000 of ORDINARY STOCK in the Guildford Gaslight and Coke Company, ranking for a Standard Dividend of 5 per cent. per annum.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of Executors and other Owners.

GAS AND WATER STOCKS AND SHARES (DEBENTURE AND ORDINARY) IN THE

Lea Bridge District Gas Company.
Aldershot Gas and Water Company.
New Swindon Gas Company.
Uxbridge and Hillingdon Gas Company; Gaslight and Coke Company; Commercial Gas Company; Portsea Island Gas Company; Maldon Gas Company; Ilford Gaslight and Coke Company.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, London, E.C., on Tuesday, July 6, at Two o'clock, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

THE "COOMBE" DRAUGHT SCREEN
FOR INCANDESCENT BURNERS.

For Illustration and Statement of Advantages to be gained by its use, see "JOURNAL," June 1, p. 1271.
ALFRED ARCULUS & CO., Glass Manufacturers,
BIRMINGHAM.

Price 7s. 6d., Demy 4to., Limp Cloth.
THE FLOW OF GASES
AND
PROPORTIONING GAS-MAINS.
FOUR DIAGRAMS
(with Explanatory Pamphlet),
Invented by
F. SOUTHWELL CRIPPS, Assoc.M.Inst.C.E.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

E. ASQUITH & CO.,
Hydraulic Engineers,
17, Mather Street, Ancoats, Manchester,
Fit up Plants for
Pressing Anthracene, Naphthalene, &c.
Competent Men sent out to erect same. Estimates given.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.
For Particulars, Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

HOLMSIDE GAS COALS.
PRESENT DAILY PRODUCE OVER 4000 TONS.
LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.
PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.
RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
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Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

TROTTER, HAINES, & CORBETT,

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FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

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THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	. .	10,500 Cub. Ft.
Illuminating Power	. .	16·9 Candles.
Coke (of good quality)	. .	67·5 per Cent.
Sulphur	. . . . .	0·58 ,,
Ash	. . . . .	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

STAFFORDSHIRE THE STEEL TUBE Co.

TELEGRAMS:

"EVESON, BIRMINGHAM."

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

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Available output up to 5000 tons per day. Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

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S. J. DITCHFIELD,

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ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

BOLDON GAS COALS.

ANALYSIS.

Yield of Gas per ton	. .	10,500 Cubic Feet.
Illuminating Power	. .	16·9 Candles.
Coke	. . . . .	66·7 Coke.
Sulphur	. . . . .	0·86 Sulphur.
Ash	. . . . .	2·04 Ash.

For Prices, &c., apply to

W. H. PARKINSON,

The Harton Coal Company, Ltd.,

NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

HANNA, DONALD, & WILSON,

(Established 1851),

GAS ENGINEERS & CONTRACTORS,

Abercorn Foundry and Abbey Works,

PAISLEY, N.B.,

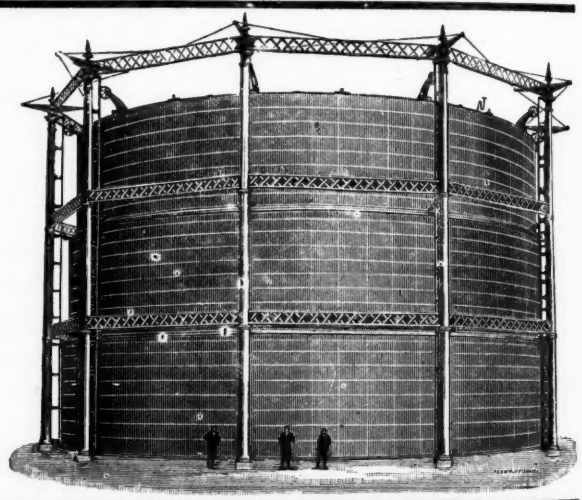
MAKERS OF

Gasholders and Gas Plant

OF EVERY DESCRIPTION.

Sole Agents for Scotland for the Automatic Coal-Gas Retort (Inclined System) Company, Limited.

Telegraphic Address: "Donald, Paisley."



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OUGHTIBRIDGE, NEAR SHEFFIELD.

ESTABLISHED 1858. **Trade Mark SILICA.**

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY FOR GAS-FURNACES.

GANISTER BRICKS,

SHOWING LITTLE OR NO SHRINKAGE.

"HOLDSOWN" CEMENT,

FOR PATCHING RETORTS AND FURNACES TO WITHSTAND THE HIGHEST HEATS.

These Goods, on account of their GREATER DURABILITY, are used by the largest Gas-Works in the World.

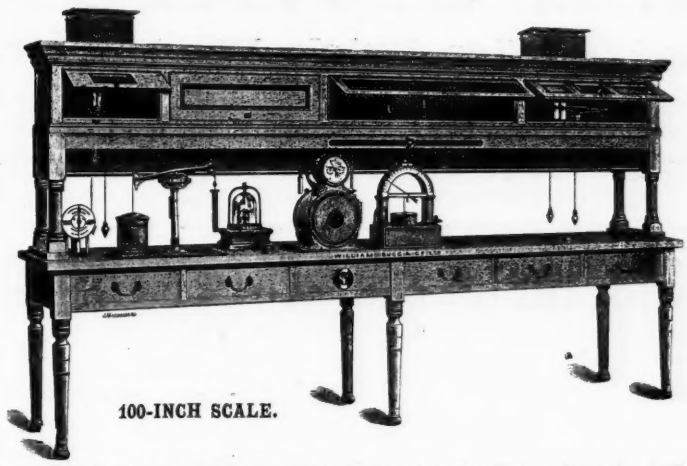
SUGG'S PHOTOMETERS

Are Used all over the Globe.

FIRST-CLASS "EVANS" PHOTOMETER,

In Accordance with the Gas-Works Clauses Act.

As supplied to the Corporation of the City of London and to many of the Principal Gas Companies.



100-INCH SCALE.

Does not require a Dark Room. Supplied with Black Velvet Canopy & Curtain to fall round operator.

As now Certified by the Standards Department of the Board of Trade.

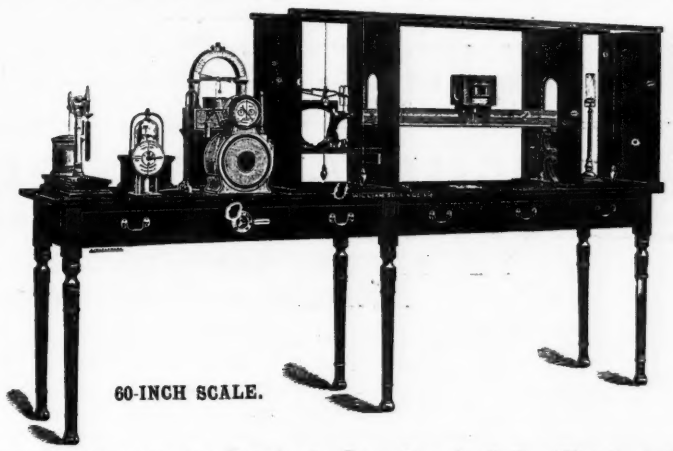
Mr. WILLIAM SUGG is the ORIGINAL and ONLY MAKER

of the "LETHEBY" and "EVANS" PHOTOMETERS as specified by the Gas-Works Clauses Act.

FIRST-CLASS "LETHEBY" PHOTOMETER,

ORIGINAL PATTERN, as Specified by the Gas-Works Clauses Act.

Also made in a cheaper form, suited to the requirements of small Gas-Works, which can be stamped by the Standards Department.



60-INCH SCALE.

Also supplied with Meter, King's Gauge, &c., on Separate Table (which can be placed in any convenient position), for use in Small Rooms.

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ALL THE METROPOLITAN TESTING-STATIONS

have been fitted up throughout, including Gas-Testing Apparatus, and Ventilating and Hot Water Work, by WILLIAM SUGG and

WILLIAM SUGG & CO.,

LIMITED,

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HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

And at Pharos Works, Hackney Wick.

NAPHTHA AND GASOLINE DISTILLERS AND PETROLEUM IMPORTERS,

Specially distil Carburine Spirit, specific gravity ·680, or of any other grade suitable for Enriching Gas; also Gas Oil best adapted for injecting into the Retorts, as in the Herring Process.

Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Pentane, Petroleum Ether, and Naphtha for clearing the pipes of Naphthaline, &c.

Samples and Prices may be had on application.

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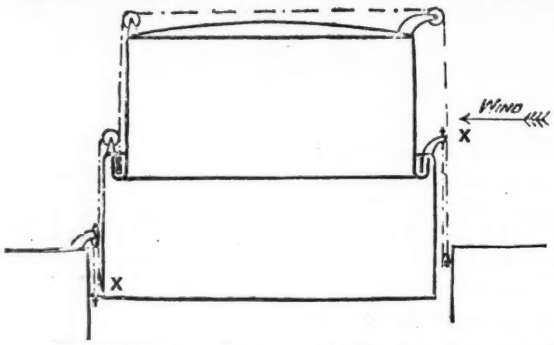
FIRE-BRICKS of the highest Quality, made from Fire-Clay of a most Superior and Refractory Character, suitable for **GLASS-WORKS, GAS-WORKS, and BLAST-FURNACES.**

WHITE GLAZED AND SALT GLAZED BRICKS, BUFF FACING BRICKS, &c.

For Prices and Analysis, apply as above.

THE CABLE SYSTEM THE SIMPLEST GASHOLDER SUPPORT.



ONE $\frac{3}{4}$**-inch Steel Cable in Double Purchase has a controlling power of** **60 TONS**

WIND at 30 lbs. per foot has an overturning power of less than **9 TONS**
in the case of a Holder of Two Lifts, 100 ft. by 20 ft.

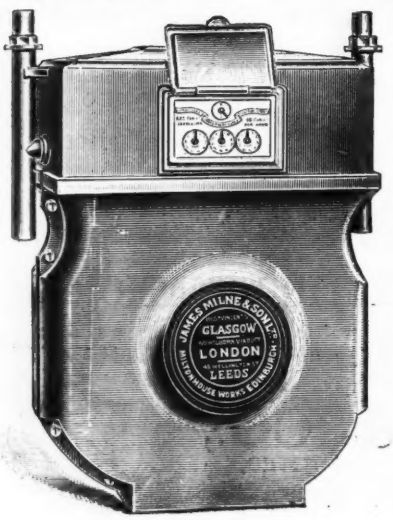
A Gasholder on the Cable System can rely on a support which is exactly known in amount, is direct and simple in application, and is exerted through the strongest parts of the framework only.

A list will be published next week of some of the 52 Cable Holders erected or on order.

N.B.—If the holder were always at one height, the Cables might be fastened at XX. *The support that the Holder derives from the Cables is equally perfect, notwithstanding its rise and fall.*

ASHMORE, BENSON, PEASE, & CO., LTD., STOCKTON-ON-TEES.

MILNE'S PATENT COMPOSITE DRY GAS-METER



THE WORKING PARTS OF A TIN-CASE DRY METER ENCLOSED IN A TWO-PART IRON-CASE.

THIS Meter combines all the advantages of the Dry Gas-Meter with the strength and durability of the Wet Meter. It consists of Cast-Iron Cases front and back enclosing the bellows, and screwed to each other with the Division-Plate between; while the upper portion containing the Valve Chambers and Index is made of extra thick Tinned Iron—the Side Tubes being made of brass, with suitable provision for Trapping any Condensation.

It is well known that the only parts of an ordinary Tin-Case Dry Meter which are attacked by outside Corrosion are the bottom and the lower parts of the Sides, and also the Side Tubes. In this Composite Meter, these parts are made either of Cast Iron or Brass, and thus rapid deterioration is prevented, and the weight is not unduly increased.

JAMES MILNE & SON, LTD.,

GAS ENGINEERS, Milton House Works, EDINBURGH,

LONDON. GLASGOW. LEEDS.

THE

WINSTANLEY REGENERATIVE, GENERATOR, & SPECIALITY COMPANY,

ERECTORS OF RETORT-HOUSES, &c., COMPLETE

With Special Appliances, the outcome of Years of Experience. Erectors of many complete Installations of Inclined and Horizontal Settings now in use, giving exceptional satisfaction.

WINSTANLEY'S PATENTS.

WINSTANLEY'S REGENERATIVE SYSTEM IS THE ACME OF SUCCESS.

No other System its equal in Results obtained—Fuel Account the Lowest Recorded.

In many instances no Clinkering is required. Fires running during the whole Season without the insertion of a Clinkering-Bar.
Can be applied to any kind of Retort-Setting, Horizontal or Inclined; also to Brick Kilns, Glass Furnaces, &c.
Numerous Testimonials of the highest order, and from users of from **4** to **10** years, showing its value, unsurpassed by any system yet erected.
Many complete Benches in use; several Stage and Floor Houses under construction; over **350** Settings in use.

WINSTANLEY'S PATENT HYDRAULIC MAIN.

Engineers contemplating alterations or additions to Retort-House Plant should use it.
If used saves Money, as weight of Fittings are reduced from **4** cwt. to **5** cwt. per Mouthpiece.

WINSTANLEY'S PATENT MOUTHPIECE FASTENING AND CATCH

Is "**UNIQUE**," easy to Fasten, makes a Light and Clean Face. No Screws or Eccentrics to wear out, or Pins to alter to take up Wear. Will last for Years.

Apply to G. ATHERTON WINSTANLEY, Kenilworth Road, COVENTRY; or G. WINSTANLEY, Gas-Works, COVENTRY.

EDWARD COCKEY & SONS, LIMITED,

ENGINEERS & CONTRACTORS FOR GAS-WORKS,

MAKERS OF FISH AND SMITH'S PATENT (NO. 5108) OVERFLOWS FOR REGULATING THE SEAL IN GAS-WASHERS, &c.

TELEGRAPHIC ADDRESS: "COCKEYS FROME."

Improved Dry-Faced Centre Valves for Working either One, Two, Three, or Four Purifiers at one time; giving an increase of Purifying Area above that obtainable with ordinary Centre Valves of 33⅓ per Cent.

PRICES ON APPLICATION TO THE SOLE MAKERS.

THE IRON-WORKS, FROME SELWOOD, SOMERSET.

London Office: BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C. *BALE AND HARDY, Agents.*

4,444

"MELDRUM" FURNACES

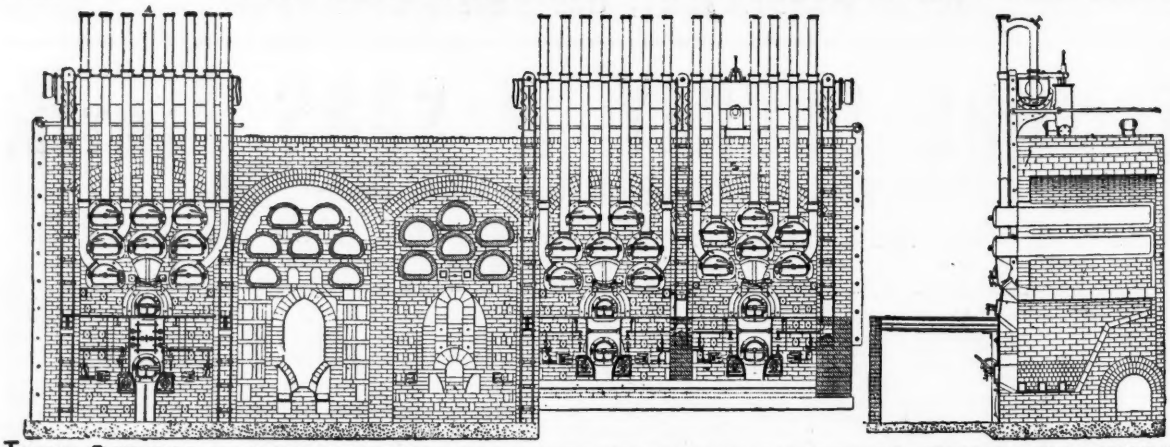
MADE TO DECEMBER 16th, 1896.

No Gas-Works should be without. WRITE FOR CATALOGUE & TESTIMONIALS.

MELDRUM BROS., ATLANTIC WORKS, MANCHESTER,

Also at London, Leeds, Birmingham, Liverpool, Newcastle, and Glasgow.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 17 TO 20 CWT. OF ENGLISH AND 20 TO 24 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, Hamilton, Agent for Scotland and Ireland; Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B., and to whom all Inquiries should be addressed in the first instance.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
Further Information and Pamphlets from Principal Agent.

JAMES McKELVIE & Co.,

Cannel & Gas Coal Merchants,

HAYMARKET, EDINBURGH;

and 37 & 38, MARK LANE, E.C.

PRICES AND ANALYSIS

OF ALL THE PRINCIPAL

CANNEL & GAS COALS

forwarded on Application.

ESTABLISHED 1840.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

650,000,000

CUBIC FEET OF GAS PER DAY.

Among the Companies supplied are The Gaslight and Coke Company, the South Metropolitan Gas Company, Birmingham Corporation, Manchester Corporation, Rochdale Corporation, Bristol Gas Company, and many other Works, both large and small, where they have been working in some instances for the past **FOUR YEARS.**

More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital, Labour, Fuel, Wear and Tear, &c.

The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

SOLE AGENTS FOR REDWOOD & CLOWES' INFLAMMABLE VAPOUR & GAS DETECTORS.

Dealers in Carburine and all other Naphthas for the Enrichment of Gas.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

CLAYTON SON & Co LTD

MAKERS OF

WORKS LEEDS

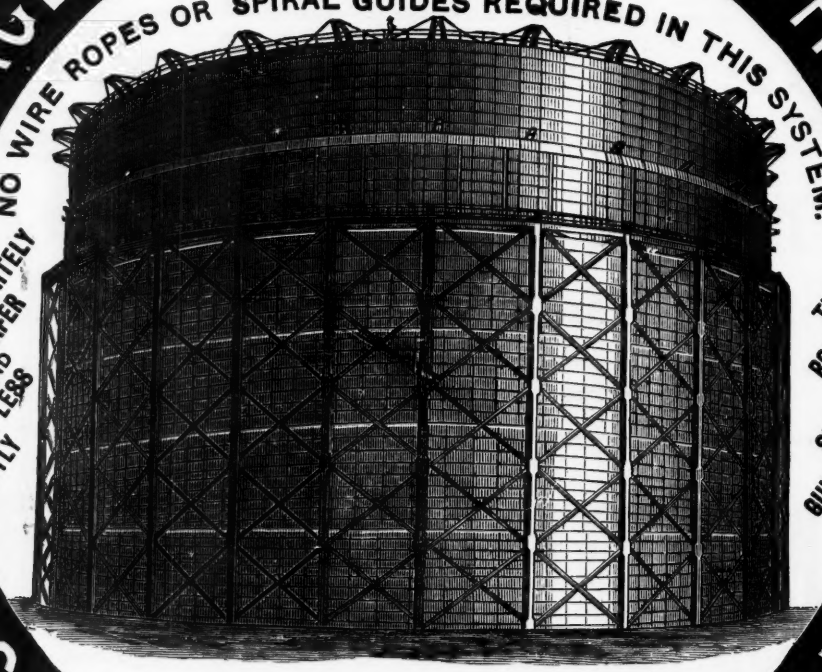
THE LARGEST GASHOLDER IN THE WORLD

CAPACITY 12 MILLION CUBIC FT

GASHOLDERS OUR SPECIALITY

NO WIRE ROPES OR SPIRAL GUIDES REQUIRED IN THIS SYSTEM.

INFINITELY SAFER AND FAR LESS COSTLY THAN ROPES OR SPIRAL GUIDES.



ERECTED AT EAST GREENWICH FOR THE South Metropolitan Gas Company IT HAS SIX LIFTS 30 FT DEEP EACH AND IS 300 FT DIAR

MAKERS OF GAS PLANT OF EVERY DESCRIPTION

ROOFS PURIFIERS &c. ALSO

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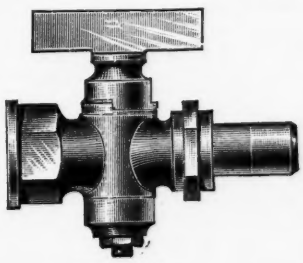
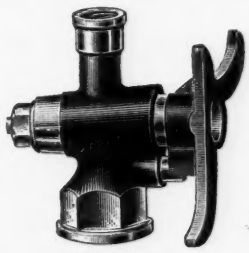
CHEMICAL LEAD-BURNING APPARATUS, COPPER SCOOPS,
PURIFIER GRIDS, TOOLS, & SUNDRIES FOR GAS-WORKS.

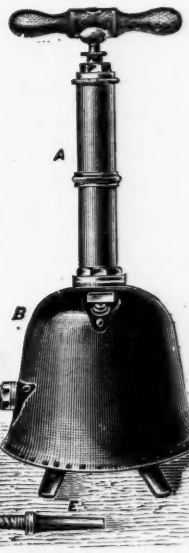
BRASS FERRULES.

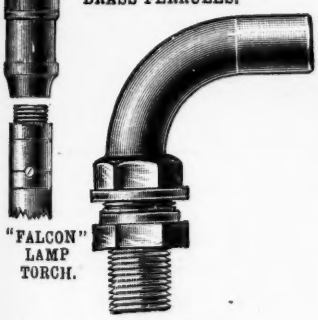


MAIN TAP.

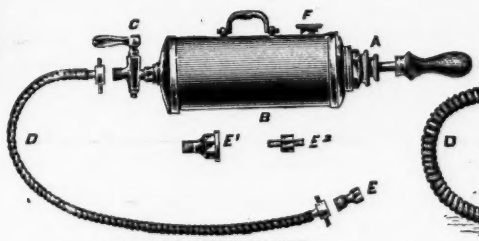


LAMP TAP.

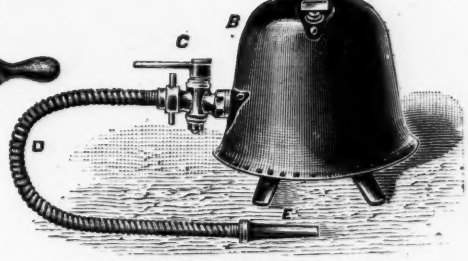




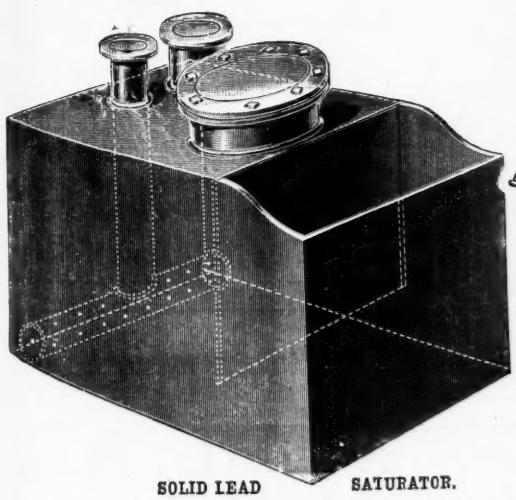
"FALCON" LAMP TORCH.



LAMP SERVICE-CLEANER.



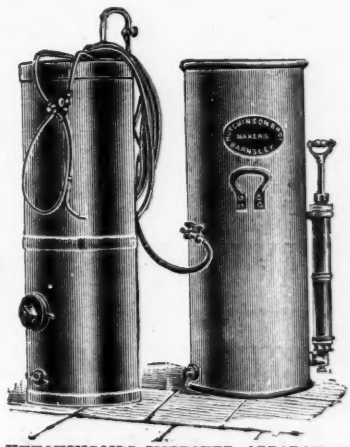
SERVICE CLEANER



SOLID LEAD SATURATOR.

BRASS OR COPPER

SYPHON PUMPS.



HUTCHINSON'S IMPROVED APPARATUS FOR CHEMICAL LEAD-BURNING.

LISTS AND PRICES ON APPLICATION.

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THE DAVIS GAS-STOVE COMPANY, LIMITED.

ENAMELLED "METROPOLITAN" GAS KITCHENERS.

No. 311. WITH TREBLE OVENS.

So unqualified has been the success of our series of **Economic Enamelled Ventilated** double-cased **Metropolitan** Gas Kitcheners (there are probably upwards of 100,000 in use in London alone), that we can only conclude the general public has found in them those special qualities which we took for the motto of our Trade Mark—

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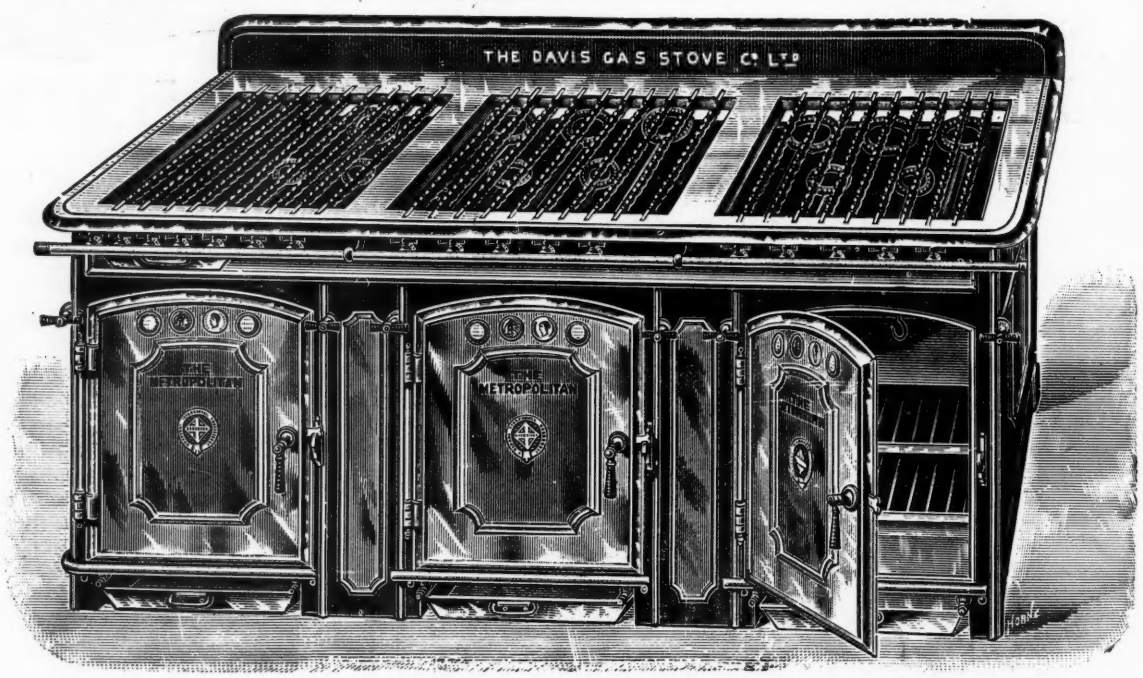
In studying our customers, we study ourselves; and the reputation we have thus far gained, we hope to maintain by continuing to make a reliable article which will do us credit, and selling it at a price which will give the purchaser the satisfaction of feeling he has received VALUE FOR HIS MONEY.



—	INSIDE DIMENSIONS OF EACH ROASTER.			HOT-PLATE.		NUMBER OF BURNERS ON HOT-PLATE.	REQUIRED SPACE.			PRICE.
	Wide.	Deep.	High.	Wide.	Deep.		Wide.	Deep.	High.	
No. 310 . .	17-in.	17-in.	27½-in.	6-ft. 0-in.	25-in.	12	6-ft. 0-in.	25-in.	34½-in.	£28 0 0
No. 310a . .	18½-in.	17½-in.	28-in.	7-ft. 0-in.	24-in.	14	6-ft. 9-in.	24-in.	35-in.	35 0 0
No. 311. . .	20½-in.	20½-in.	29-in.	7-ft. 6-in.	28-in.	17	7-ft. 6-in.	28-in.	36½-in.	42 0 0

ANY NUMBER OF THESE ROASTERS CAN BE FITTED UNDER A CONTINUOUS HOT-PLATE.

If fitted with White Enamelled Top Plates, extra as follows:—

No. 310 .. .. **22/6** No. 310a .. .. **27/-** No. 311 .. .. **30/-**

MANUFACTURERS OF GAS, STEAM, & HOT WATER APPLIANCES.

TEN GOLD MEDALS. NUMBERLESS SILVER AND BRONZE MEDALS.

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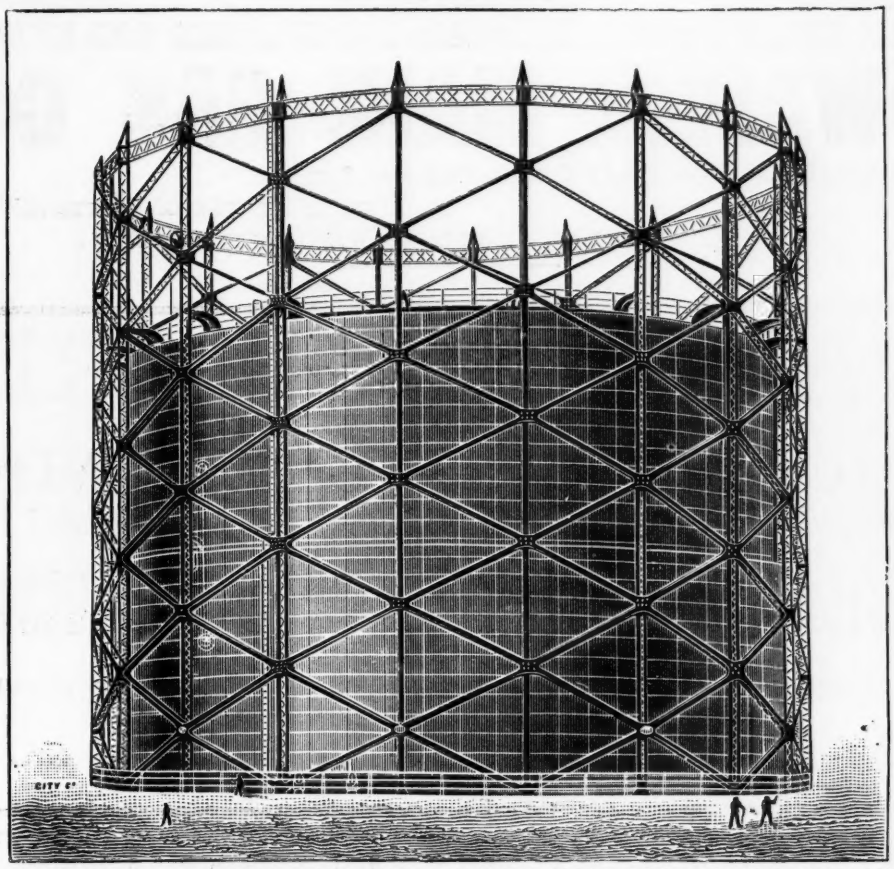

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St. Mary Cray	78	„	26	2 „	Southend	90	„ 25 2 „
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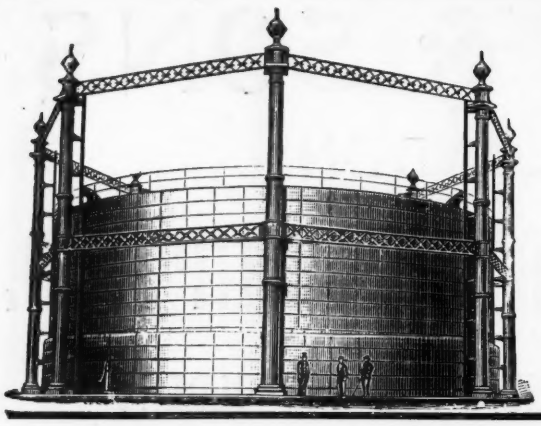
9 SETS IN OPERATION OR IN COURSE OF CONSTRUCTION.



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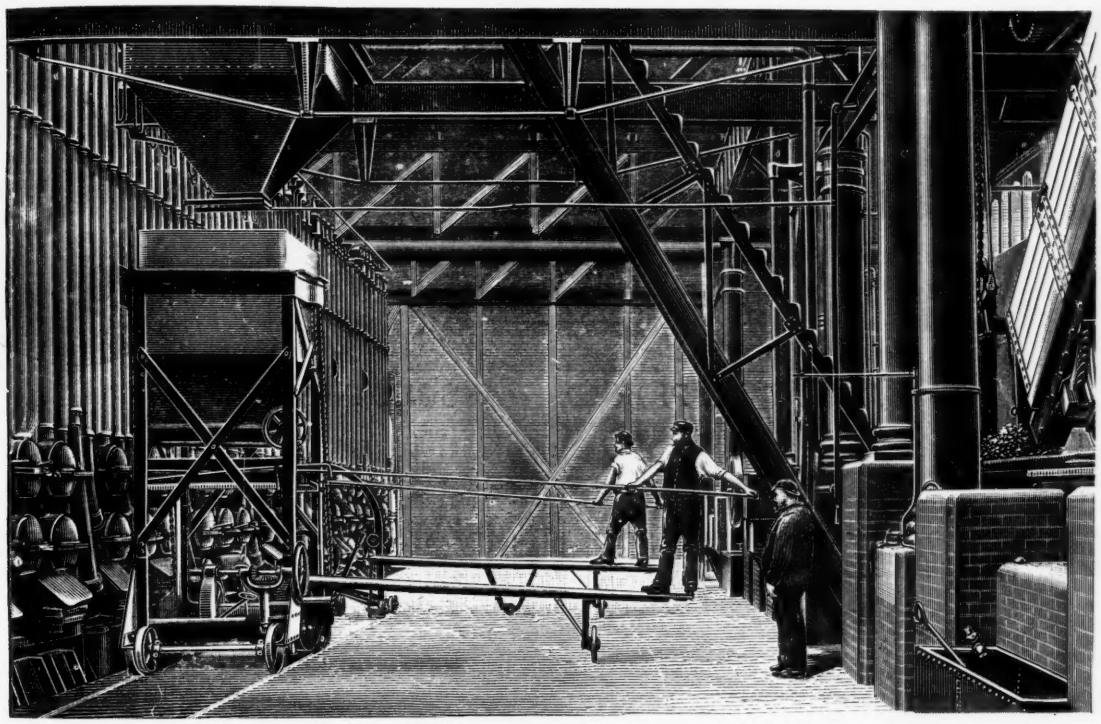

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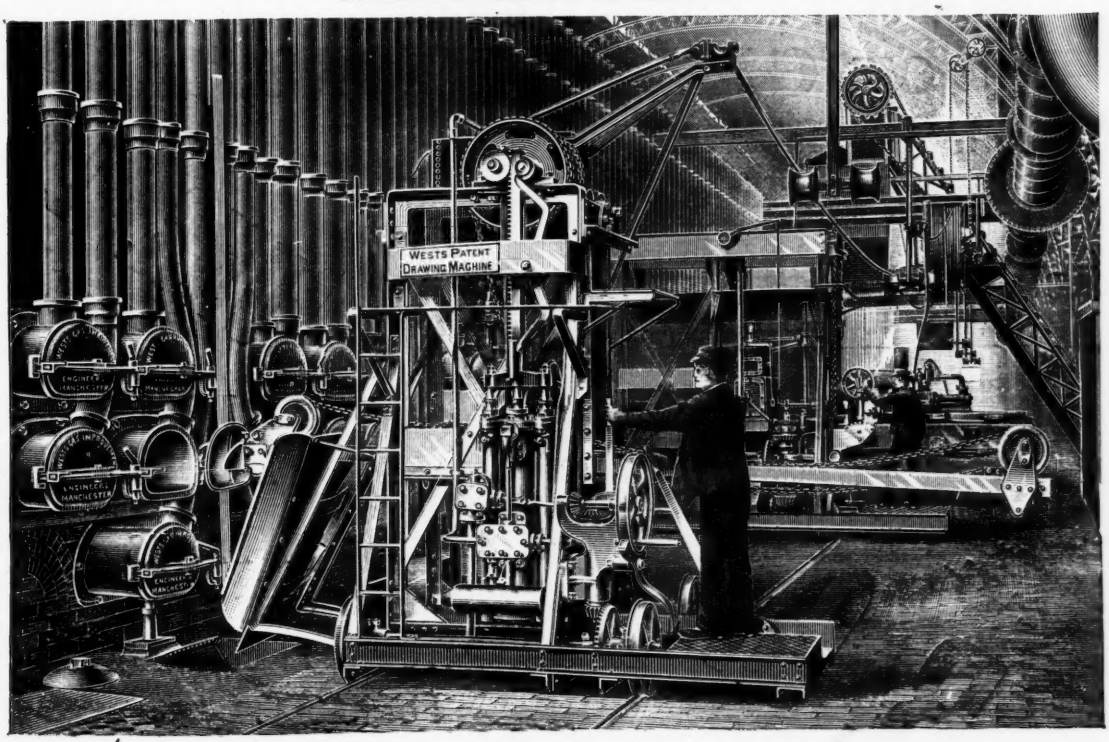

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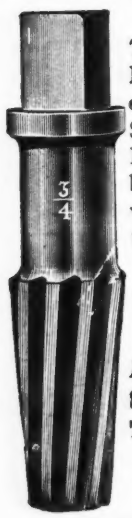

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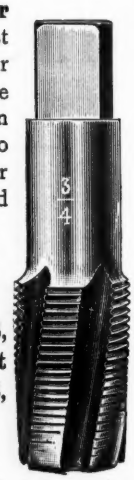

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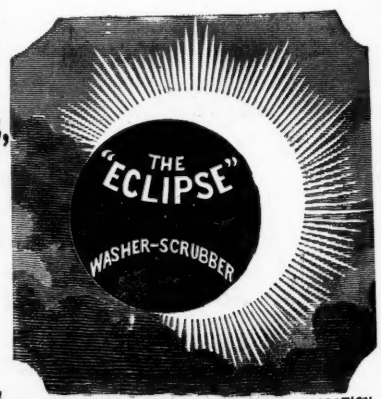

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